

Reference manual  
Advanced Signal Calibrator  
**Jofra ASC-400**



# Reference Manual

## Advanced Signal Calibrator

### JOFRA ASC-400

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## About this manual....

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- **The structure of the manual**

This reference manual is aimed at users who are familiar with AMETEK signal calibrators, as well as those who are not. The manual is divided into 12 chapters, which describe how to set up, operate, service and maintain the signal calibrator. The technical specifications are described and accessories may be ordered from the list of accessories.

- **Safety symbols**

This manual contains a number of safety symbols designed to draw your attention to instructions, which must be followed when using the instrument, as well as any risks involved.



### **Warning**

Conditions and actions that may compromise the safe use of the instrument and result in considerable personal or material damage.



### **Caution...**

Conditions and actions that may compromise the safe use of the instrument and result in slight personal or material damage.



### **Note...**

Special situations, which demand the user's attention.

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## 1.0 Introduction

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### ***Congratulations on your new AMETEK JOFRA Advanced Signal Calibrator!***

With the AMETEK JOFRA Advanced Signal Calibrator, you have chosen an extremely effective instrument, which we are sure will perform according to your expectations. This ASC-400 signal calibrator is a handheld, battery or DC adaptor powered instrument that measures and sources electrical and physical parameters.

During the past several years, we have acquired extensive knowledge of industrial signal calibration. This expertise is reflected in our products, which are all designed for daily use in an industrial environment. Please note that we would be very interested in hearing from you if you have any ideas or suggestions for changes to our products.

This reference manual applies to the following instrument:

- **JOFRA ASC-400**

The calibrator has the following features and functions:

- A dual colour display.  
The upper display is used for the measurement of volts, current, pressure, %error, scaling and switch test  
The lower display can be used to measure and source volts, millivolts, current, pressure, resistance, resistance temperature detectors (RTDs), thermocouples, frequency, and resistance, and to source pulse trains.
- A thermocouple (TC) input/output terminal with automatic and manual reference-junction (cold junction) temperature compensation.
- An interactive and intuitive user interface
- USB interface for remote control
- Isolated read back for transmitter calibration.
- A BARO option turning any gauge measuring APM into an absolute measuring device.
- Extended and comprehensive pressure measurement capabilities with JOFRA advanced pressure modules (APM)

#### **ISO-9001 certified**

AMETEK Denmark A/S was ISO-9001 certified in September 1994 by Bureau Veritas Certification Denmark.

#### **CE-label**



Your new signal calibrator bears the CE label and conforms to the EMC Directive.

## **Technical assistance**

Please contact the dealer from whom you acquired the instrument if you require technical assistance.

## **1.1 Warranty**

This instrument is warranted against defects in workmanship, material and design for two (2) years from date of delivery to the extent that AMETEK will, at its sole option, repair or replace the instrument or any part thereof which is defective, provided, however, that this warranty shall not apply to instruments subjected to tampering or, abuse, or exposed to highly corrosive conditions.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED AND AMETEK HEREBY DISCLAIMS ALL OTHER WARRANTIES, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY. AMETEK SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, ANY ANTICIPATED OR LOST PROFITS.

This warranty is voidable if the purchaser fails to follow any and all instructions, warnings or cautions in the instrument's User Manual.

If a manufacturing defect is found, AMETEK will replace or repair the instrument or replace any defective part thereof without charge; however, AMETEK's obligation hereunder does not include the cost of transportation, which must be borne by the customer. AMETEK assumes no responsibility for damage in transit, and any claims for such damage should be presented to the carrier by the purchaser.

## **1.2 Receiving the Advanced Signal Calibrator**

### **When you receive the instrument...**

- 1) Unpack and check the signal calibrator and the accessories carefully.
- 2) Check the parts according to the list shown below.

If any of the parts are missing or damaged, please contact the dealer who sold you the signal calibrator.

### **You should receive:**

- 1 ASC-400 Calibrator
- 1 electronic Reference manual on USB memory stick
- 2 sets of test leads and test clips (black and red)
- 1 carrying soft bag
- 1 USB cable
- 6 x AA batteries
- 1 Calibration certificate (International traceable)

When reordering, please specify the part numbers according to the list of accessories, section 12.0

1.3     Dimensioning drawing





## 2.0 Safety instructions

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### Read this manual carefully before using the instrument!

Please follow the instructions and procedures described in this manual. They are aimed at allowing you to make the best of your signal calibrator and avoid any personal injuries and/or damage to the instrument.



### Disposal – WEEE Directive

The signal calibrator contains Electrical and Electronic circuits and must be properly recycled or disposed of (in accordance with the WEEE Directive 2012/19/EU).



### Warning

The signal calibrator is designed to calibrate and measure low voltage process signals. To ensure the safety of the operator and the instrument, **DO NOT** connect the signal calibrator to input voltages above 30 Volts.

#### To avoid possible electric shock or personal injury:

- Do not apply more than the rated voltage. See specifications for supported ranges.
- Follow all equipment safety procedures.
- Never touch the probe to a voltage source when the test leads are plugged into the current terminals.
- Do not use the calibrator if it is damaged. Before you use the calibrator, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.
- Select the proper function and range for your measurement.
- Make sure the battery cover is closed and latched before you operate the calibrator.
- Remove test leads from the calibrator before you open the battery door.
- Inspect the test leads for damaged insulation or exposed metal. Check test leads continuity. Replace damaged test leads before you use the calibrator.
- When using the probes, keep your fingers away from the probe contacts. Keep your fingers behind the finger guards on the probes.
- Connect the common test lead before you connect the live test lead.  
When you disconnect test leads, disconnect the live test lead first.
- Do not use the calibrator if it operates abnormally. Protection may be impaired. When in doubt, have the calibrator serviced.
- Do not operate the calibrator around explosive gas, vapour, or dust.
- When using a pressure module, make sure the process pressure line is shut off and depressurized before you connect it or disconnect it from the pressure module.
- Disconnect test leads before changing to another measure or source function.
- When servicing the calibrator, use only specified replacement parts.
- To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the battery indicator appears.
- To avoid a violent release of pressure in a pressurized system, shut off the valve and slowly bleed off the pressure before you attach the pressure module to the pressure line.
- To avoid personal injury or damage to the calibrator, use only the specified replacement parts and do not allow water into the case.



### Caution...

**To avoid possible damage to the signal calibrator or to the equipment under test:**

- Disconnect the power and discharge all high-voltage capacitors before testing resistance or continuity.
- Use the proper jacks, function, and range for your measurement or sourcing application.
- If the message changes to "OL" the range limit is exceeded and the pressure source must immediately be removed from the APM to prevent damage to the pressure transducer inside.
- To avoid damaging the pressure module from overpressure, never apply pressure above the rated maximum printed on the module.
- To avoid damaging the plastic lens and case, do not use solvents or abrasive cleansers.
- When using the switch test function, make sure that no other equipment, such as heavy loads or sources, is connected in the test loop.

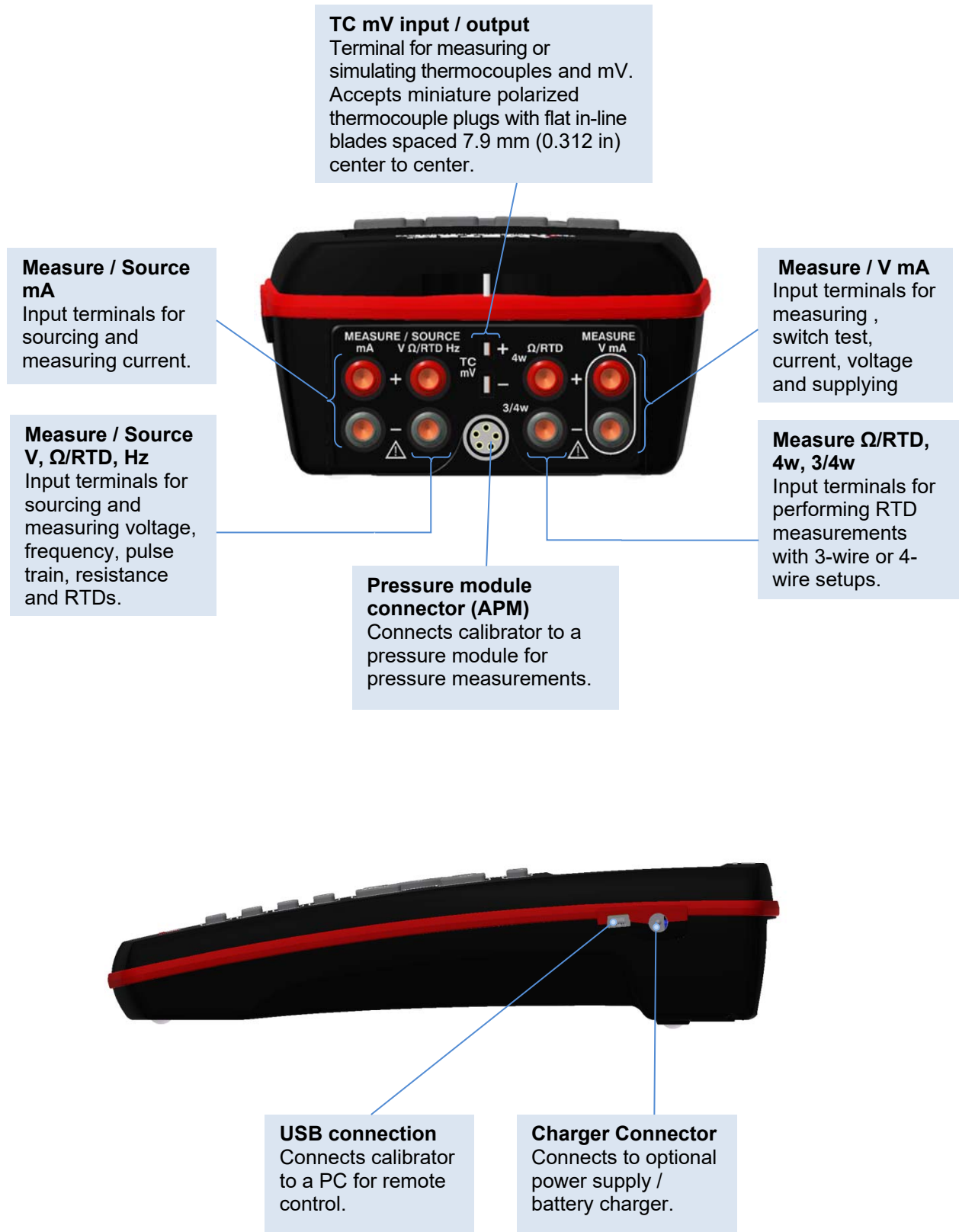


### Note...

The product liability **only** applies if the instrument is subject to a manufacturing defect. This liability becomes void if the user fails to follow the maintenance instructions described in this manual or uses unauthorized spare parts.

## 3.0 Calibrator Interface

### 3.1 Input/Output Connections



## 3.2 Keypad - Functions

### Power key/ Backlight key

Turn the calibrator on and off. Press the button for five seconds to turn it off. Adjust the backlight intensity.

### Arrow Keys

Have different functions depending on the mode of operation. In navigation mode, they move the cursor in the desired direction. In edit mode, they roll in the list of options or if entering a number, the arrow left and arrow right move the cursor one character in the desired direction.

### Zero key

Zero Pressure Module reading.

### Numeric Keypad

Allows user to enter Numeric values in both upper and lower display.



### Function keys F1, F2, F3, F4

To operate the menu bar at the bottom of the calibrator display, use the F-keys.

### Back key

Cancel a selection / edit or return to previous menu.

### Action key / Enter key

Action function: Open and close edit fields or a menu button. The action key also accepts the selected option or entered value.

Enter function: Accept selected options or entered values. When a value is entered with the Enter Key the cursor selects the next value field in the list.

### Configuration key

Opens and closes configuration mode.

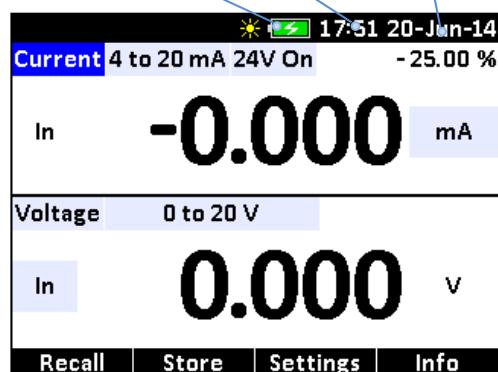
## 3.3 Main display - Functions

### Battery icon.

Remaining power and attached power adapter

### Real Time Clock display

### Date display



### Upper display

The upper display is used for measuring DC voltage, DC current with and without loop power, pressure, percent, error, scaled value, switch test.

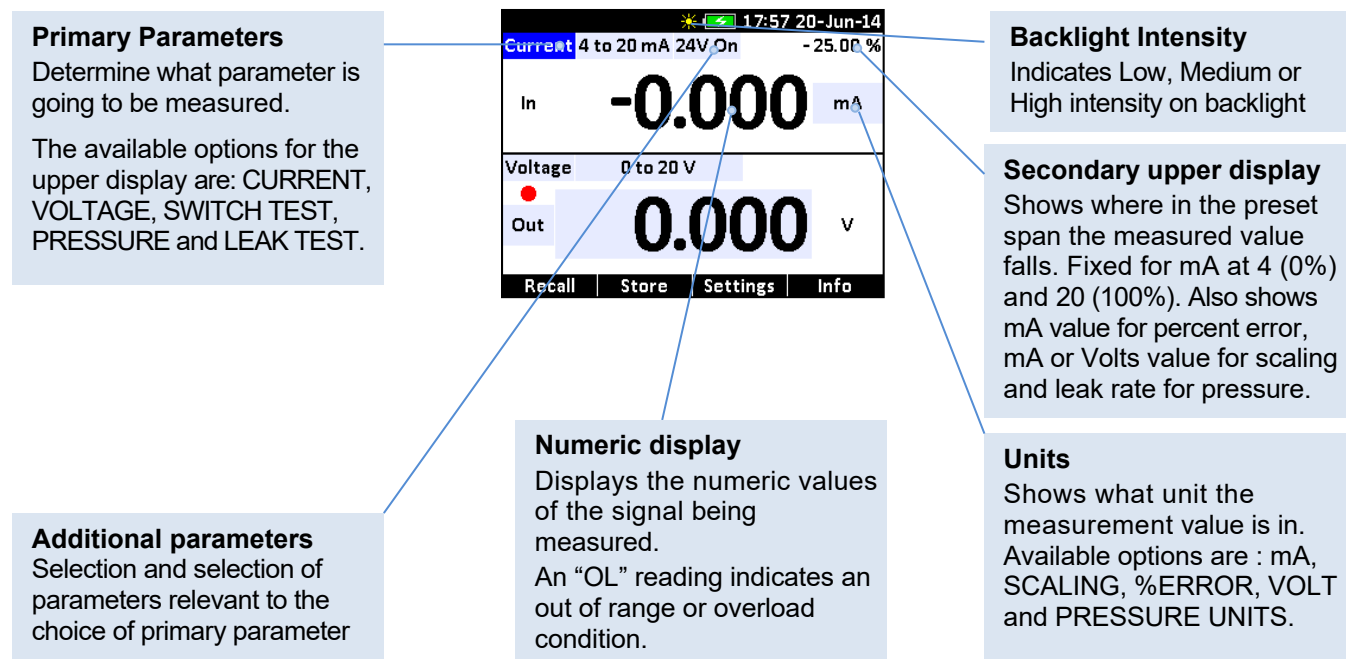
### Lower display

The lower display can be used for both measuring and sourcing.

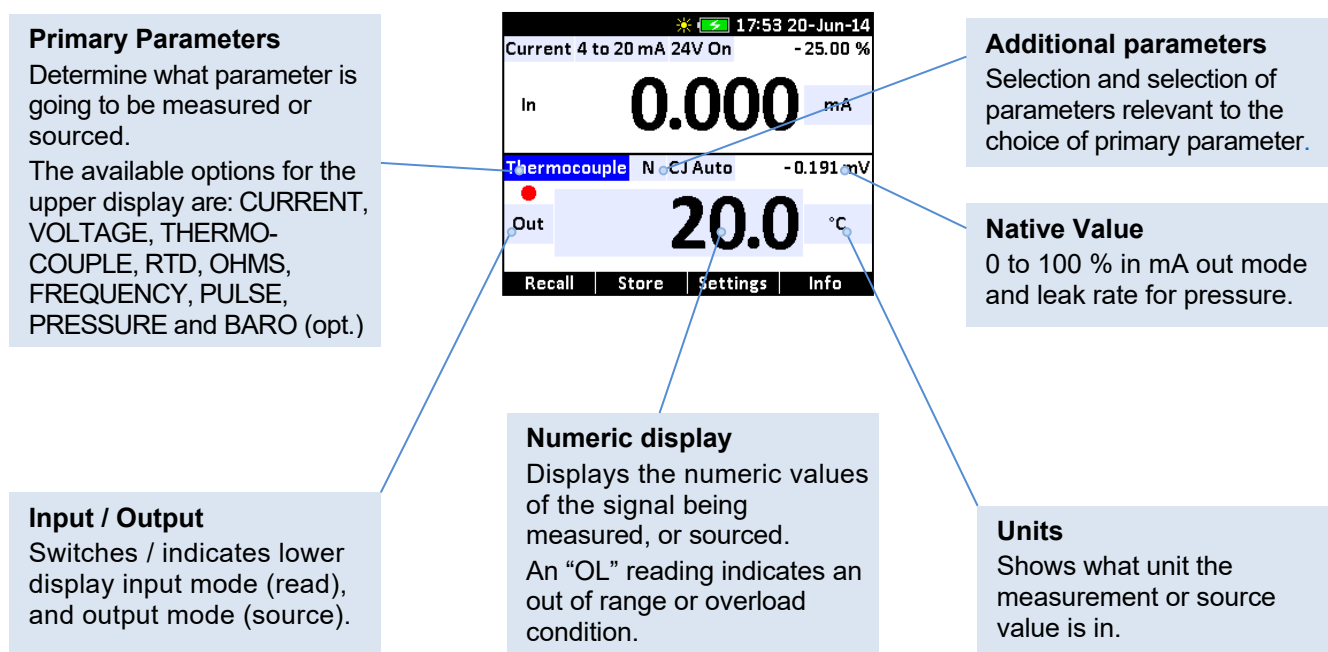
### Horizontal menu bar

The menu bar is used to setup both the upper and the lower display to perform the desired function. The function keys (F1, F2, F3 and F4) are used to navigate through all the levels and choices of the menu bar.

### 3.4 Upper display (Read-back display) - Functions



### 3.5 Lower display (Primary display) – Functions



## 4.0 Operating the calibrator



### Warning

Please inspect the Safety Instructions in section 2.0 before using the instrument.



### Caution...

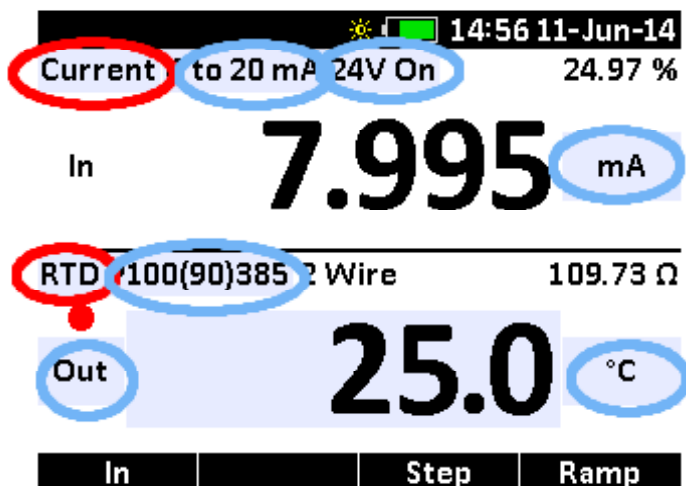
Please inspect the Safety Instructions in section 2.0 before using the instrument.



Connect USB cable and APM before switching on the instrument, or before applying DC power.

### 4.1 Basic operation (Setup)



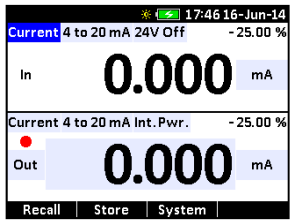

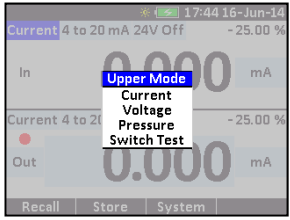

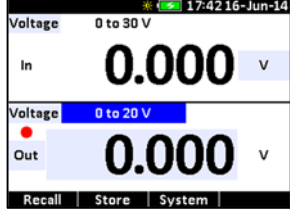

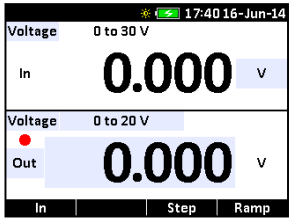
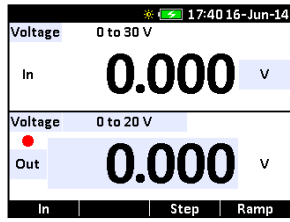

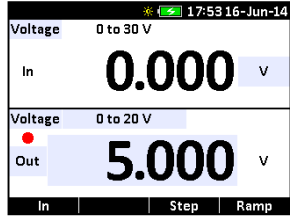





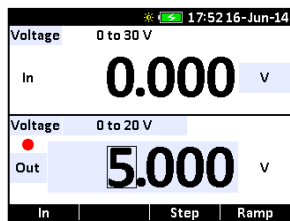
1. Select mode for upper and lower display (**RED markers**).
2. Select the related options and functions for the selected modes (**BLUE markers**)



### Note...


the light blue fields; they indicate a parameter / function that can be selected or altered in edit mode. This works like a build in user manual, indicating the changeable parameters for the selected mode at all times.

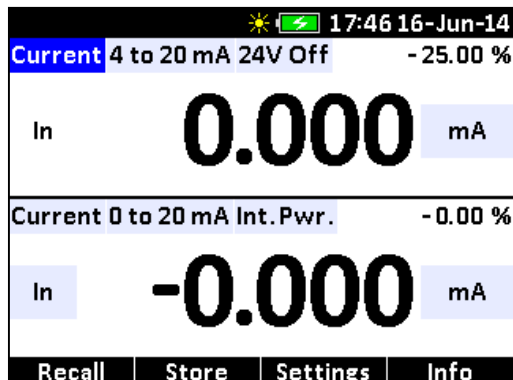
## 4.2 The principle of navigating through a Setup


| ACTION   | SCREEN DISPLAYED  |
|--|---|
| <p>1. Press  to access edit mode.</p> <p>2. Use the  (ARROW) keys to move between the parameter fields.</p>  |    |
| <p>3. Press  to access the various Parameter lists to choose from.</p> <p>4. Start by selecting upper or lower display.</p>   |    |
| <p>5. Use the  (ARROW) keys to move between the parameter fields and make more changes...</p>   |    |
| <p>6. Press  to accept the selections and leave the edit mode.</p>   |   |
| <p>7. Use the numeric keys to enter an output value (if output is chosen).</p>   |  |
| <p>8. Press  to accept the value.</p>   |  |
| <p>9. Or use the  (ARROW) keys to enter "fine adjust" mode.<br/>Move the value-frame to the right or left using the  or  keys. Modify the digits using the  or  keys.</p> |  |

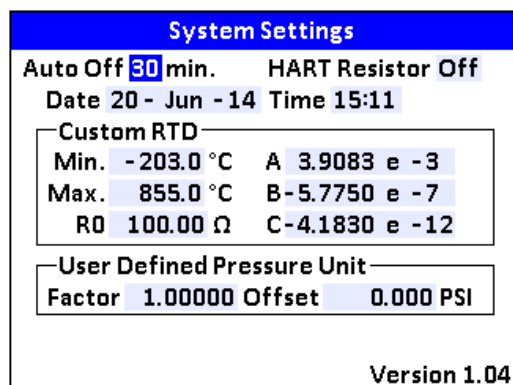
## 4.3 System Settings




The System Settings setup can be accessed at any stage of operation:

1. Press  to display the Horizontal menu bar.

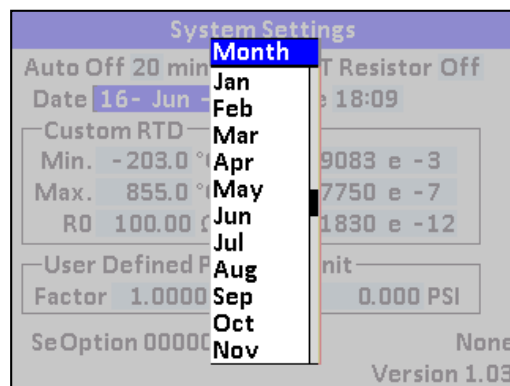
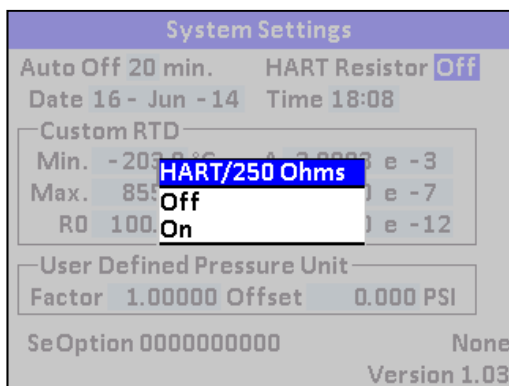







2. Press  (System) to access the System Settings.



3. Use the  (ARROW) keys to move between the setting fields.
4. Press  to open a setting field for editing.
5. Use the numeric keys to enter the desired value and press  to accept the value.

When entering the HART Resistor ON/OFF field and Date field horizontal lists appear.




6. Use the  and  keys to scroll in the lists and select from the lists by pressing .
7. Press either  or  to exit the System Settings.

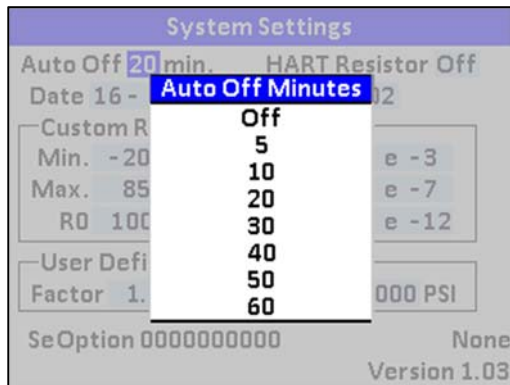




8. The calibrator resumes normal operation after a few seconds. It will return to the setup last used.

#### 4.3.1 Power Saver (Auto off)

The ASC-400 calibrator automatically turns off 5 to 60 minutes after the last keystroke. To reduce or increase this time or to disable this feature, do as follows:


1. In the System Settings setup enter the “Auto Off” setting field and press  to access the Auto Off Minutes list.

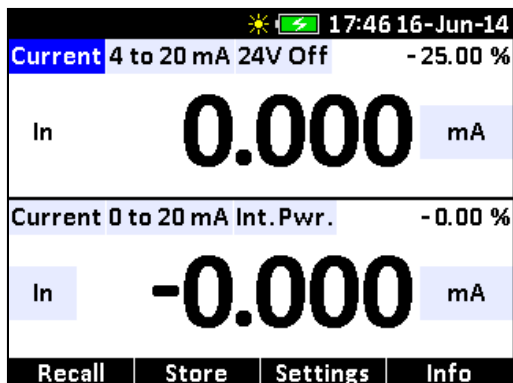



2. The list displays the turn-off time in minutes.  
Off disables the power saver and the calibrator will be permanently off.
3. Select the turn-off time by pressing .
4. Press  to exit the System Settings.

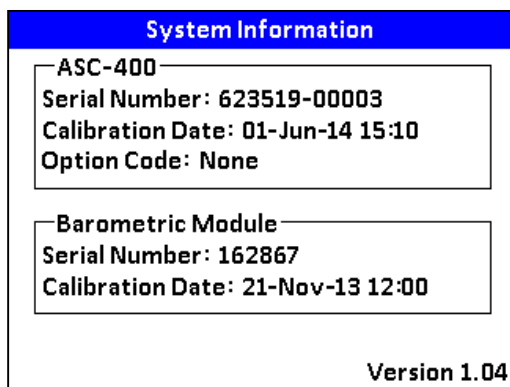
## 4.4 System Information

The System Information can be accessed at any stage of operation:

1. Press  to display the Horizontal menu bar.



2. Press  (Info) to access the System Information.



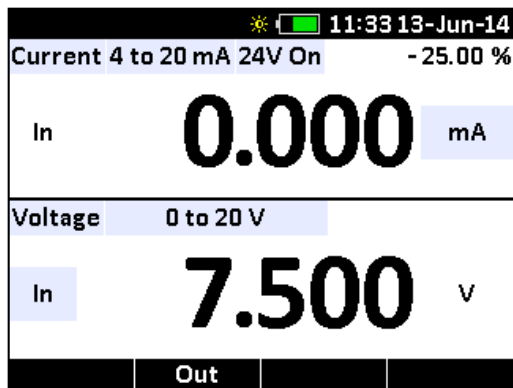
## 5.0 Using measure modes (lower display)

### 5.1 Measuring volts

The electrical parameter volts can be measured using the lower display.

To make the desired measurements, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select "Voltage" from the Lower Mode list.
2. Select the desired Range from the Range list.
3. Select the desired Test Mode (in) from the Test Mode list.
4. Accept the selections and leave the edit mode.



5. Connect the leads, as shown in Figure 1.

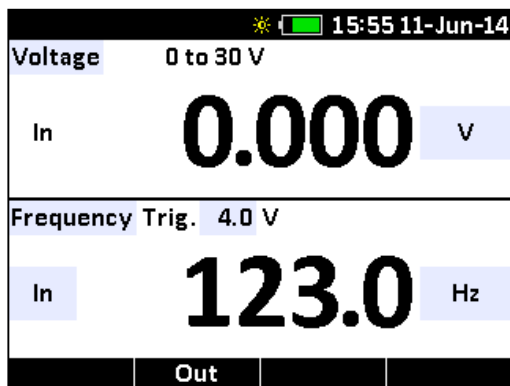


**Figure 1**  
Measuring Volts

## 5.2 Measuring frequency

The electrical parameter frequency can be measured using the lower display. To make the desired measurements, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Enter edit mode.
2. Select "Frequency" from the Lower Mode list.
3. Select the desired Test Mode (In) from the Test Mode list.
4. Enter the desired trigger level (Trig. V) value using either the ARROW keys or the numeric keys.
5. Select the desired unit from the Units list.
6. Accept the selections and leave edit mode.



7. Connect the leads, as shown in Figure 2.



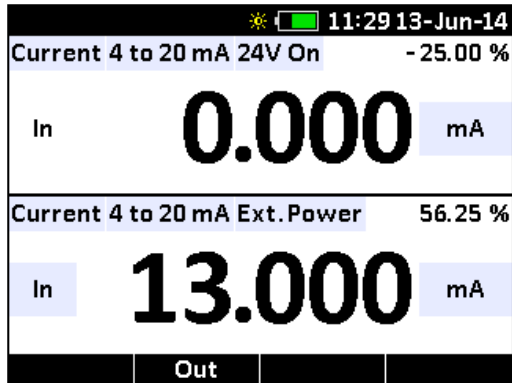
**Figure 2**  
Measuring Frequency

## 5.3 Measuring mA

The electrical parameter mA can be measured using the lower display.

Follow the principle of navigating through the functions as described in the guidelines in section 4.2 to make the desired mA measurements:

1. Enter edit mode.
2. Select “Current” from the Lower Mode list.
3. Select the desired Test Mode (In) from the Test Mode list.
4. Select the desired Range from the Range list.
5. Select the desired power source from the Power Source list.
6. Select mA or % from the Units list.



7. Accept the selections and leave edit mode.
8. Connect the leads, as shown in Figure 3.



**Figure 3**  
Measuring mA

## 5.4 Measuring Temperature

### 5.4.1 Using Thermocouples (TC)

The ASC-400 supports the following thermocouple types:

**B, BP, C, E, J, K, L, N, R, S, T, U, XK**

The characteristics of all the types are described in section 11 – Technical Specifications.

The ASC-400 has 3 cold junction Modes to choose from:

- **CJ Auto** Automatic CJ compensation, CJ temperature inside the connector is measured by a high accuracy RTD.
- **CJ Off** With CJ in OFF Mode, the calibrator will measure the difference between the thermocouple at the junction and at its TC input terminal (equivalent to 0°C CJ).
- **CJ Manual** With CJ in Manual Mode it is possible to set the desired CJ temperature to be used for temperature calculation.



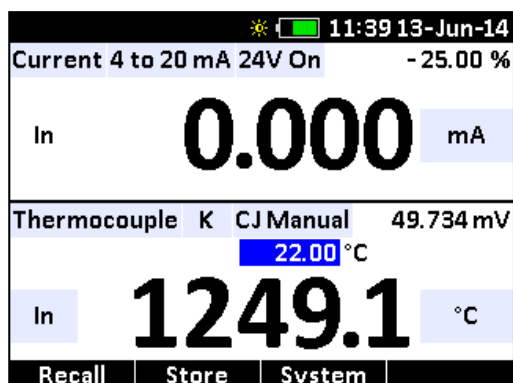
#### Note...

CJ Off Mode should only be used when calibration is being done using an external ice bath.

CJ Manual mode should be used when the cold junction temperature is known, but different from 0 °C.

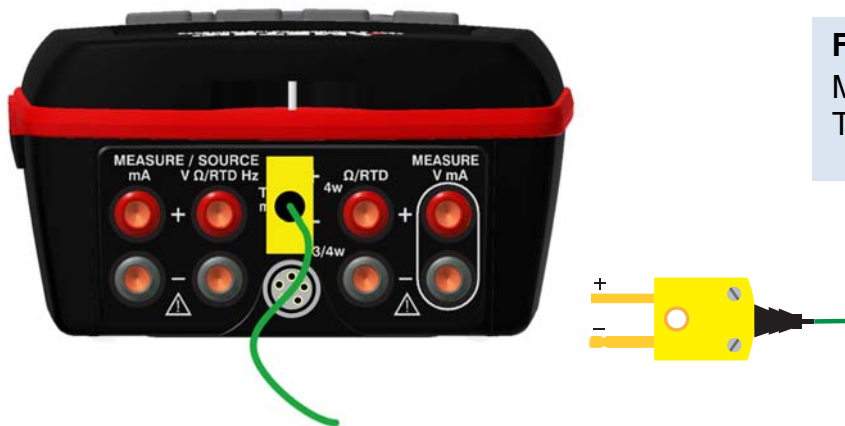
To use the thermocouple to measure temperature, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Attach the thermocouple leads to the TC mini plug, and insert the plug into the input/output of the ASC-400 calibrator, as shown in Figure 4.
2. Enter edit mode.
3. Select “Thermocouple” from the Lower Mode list.
4. Select the desired Test Mode (In) from the Test Mode list.
5. Select TC function from the TC Type list.
6. Select CJ Mode from the list.
7. If CJ Manual is selected a CJ temperature value must be entered using either the ARROW keys or the numeric keys.



8. Select the temperature unit from the Units list.

9. Accept the selections and leave edit mode.



**Figure 4**  
Measuring Temperature using  
Thermocouple Terminals



**Note...**

For best accuracy wait minimum 2 to 5 minutes for the temperature between the mini plug and the calibrator to stabilize before any measurements are taken.

Use the appropriate type of TC connector, using a wrong type of mini TC connector will cause additional CJ error.

The ASC-400 calibrator can also measure the mV of a Thermocouple, which can be used along with a table in case the corresponding TC type is not supported by the calibrator.

To select mV do as follows:

1. Select "Voltage" from the Lower Mode list.
2. Select "-10 to 75 mV" from the Range list.

In this mode the CJ compensation is turned off.



**Note...**

The TC wire used must match the thermocouple type being calibrated.

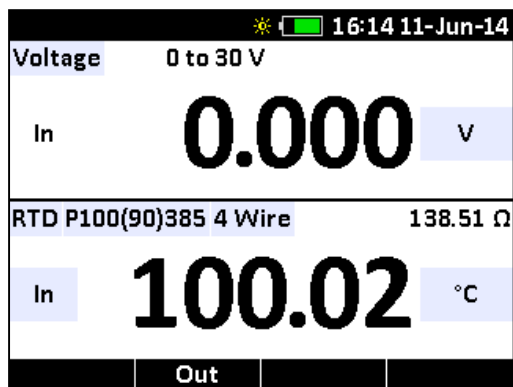
#### 5.4.2 Using Resistance-Temperature-Detectors (RTDs)

The supported types of RTDs are shown in Section 11 - Specifications.

RTDs are characterized by their 0°C resistance, R0. The ASC-400 calibrator accepts two, three, and four wire inputs, with four wire input being the most accurate.

To use the RTD option, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

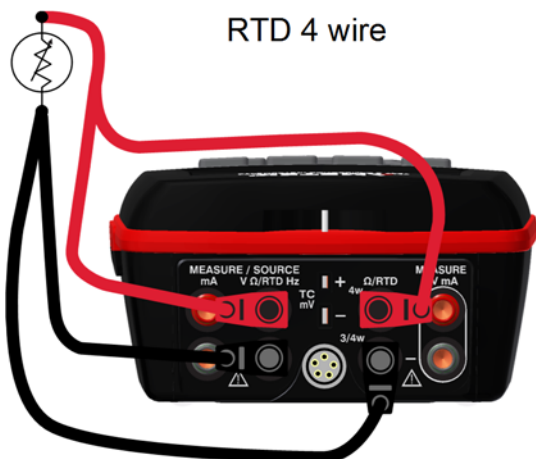
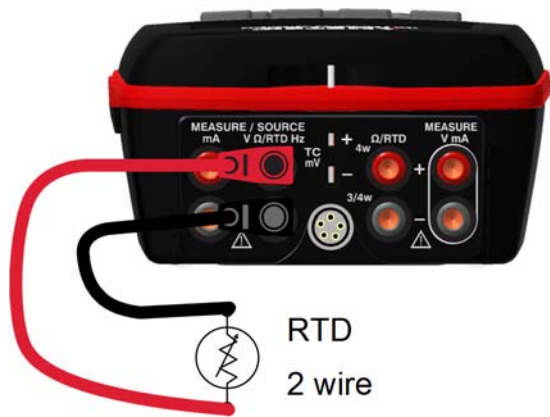
1. Enter edit mode.
2. Select "RTD" from the Lower Mode list.
3. Select "In" from the Test Mode list.
4. Select RTD type from the RTD Type list.
5. Select a wire connection from the Num. Wires list. 4-wire allows for the most precise measurement.
6. Accept the selections and leave edit mode.



7. Attach RTD leads, as shown in Figure 5

**Figure 5**

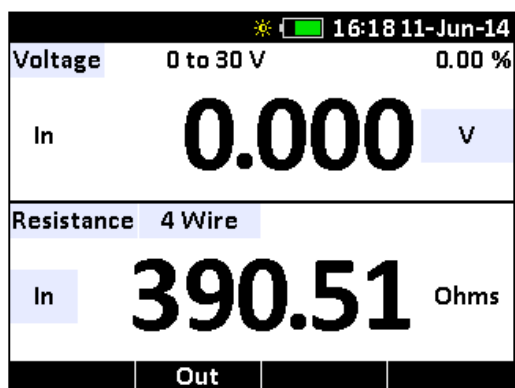
Measuring RTD temperature  
2, 3 or 4 wire connections





Resistance can also be measured using this function:

1. Select “Resistance” from the Lower Mode list.
2. Proceed as in the above guidelines.



This option can be used to measure ohms or a type resistive temperature sensor, which is not programmed into the ASC-400 calibrator.

## 5.5 Measuring Pressure



### Warning

To avoid a violent release of pressure in a pressurized system, shut off the valve and slowly bleed off the pressure before you attach the pressure module to the pressure line.



### Caution...

- To avoid damaging the pressure module from overpressure, never apply pressure above the rated maximum printed on the module.
- To avoid damaging the pressure module from corrosion, use it only with specified materials. Refer to the pressure module documentation for material compatibility.

To measure pressure, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Connect the pressure module to the ASC-400 calibrator, as shown below in Figure 6.

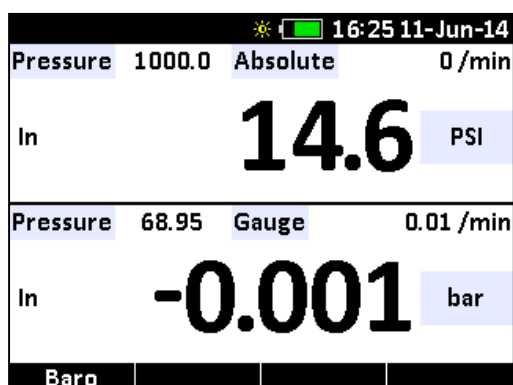


### Note...

The APM might take a while to start up. The module is a complete pressure measuring system with a microcontroller system inside.

The calibrator can measure pressure on both the upper and the lower display. This makes it possible to measure pressure in two different units at the same time.

2. Select either the upper or lower display to work from.
3. Select "Pressure" from the Upper or Lower Mode list.
4. Select type of pressure, Gauge or Absolute (If barometer is mounted in ASC-400).
5. Select the desired measuring unit from the Units list.
6. Zero the pressure module (see section 5.5.1 for using the zeroing function).
7. Leak rate is automatically calculated in the selected pressure unit / minute.






**Figure 6**  
Connections for Measuring Pressure

### 5.5.1 Zeroing with Absolute Pressure Modules (APM S, H and Mk.II)

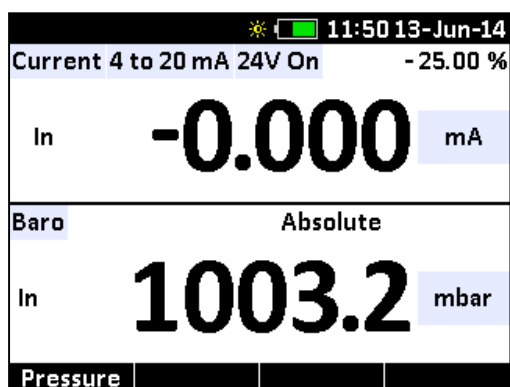
To zero, adjust the calibrator to read a known pressure, such as barometric pressure.

To adjust the calibrator, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select either the upper or lower display to work from.
2. Select "Pressure" from the Upper or Lower Mode list.
3. Press  to activate the Zeroing.
4. The calibrator stores the Barometric zero offset in non-volatile memory.  
The zero offset is stored for one absolute pressure module at a time. If a new absolute module is connected this process must be repeated.

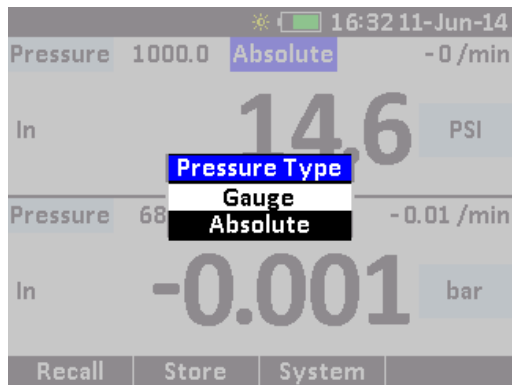
### 5.5.2 Using the BARO Module (optional)

1. The BARO barometer option in the ASC-400 calibrator has 2 functions.
  - Working as a high accuracy barometer



- Applying the barometric pressure value to the measurement of a pressure module (APM) allowing any gauge APM to be used for absolute measurements. This system is superior to ordinary absolute sensors, as the working sensor is gauge and can be zeroed at any time, compensating for potential drift.

2. If the BARO option is mounted, the pressure type field becomes active and pressure type can be selected.



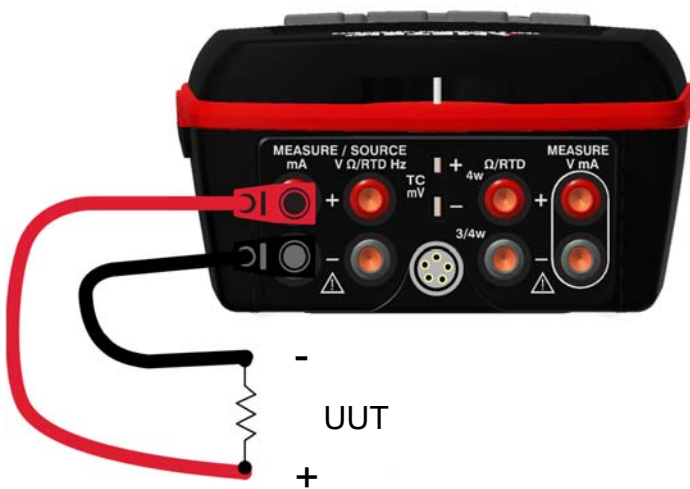
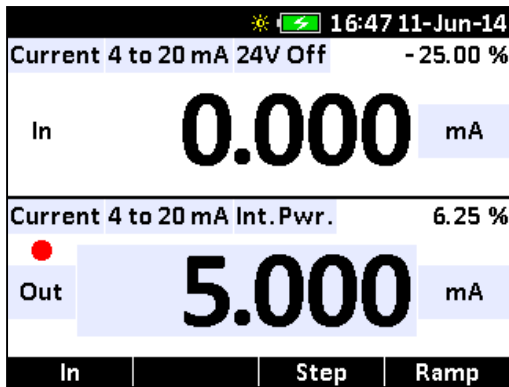
## 6.0 Using Source modes (Lower Display)

The ASC-400 calibrator can generate calibrated signals for testing and calibrating process instruments. The calibrator can source voltages, currents, resistances, frequencies, pulses, and the electrical output of RTD and thermocouple temperature sensors.

### 6.1 Sourcing mA (internal loop power supply)

To source a current, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select "Current" from the Lower Mode list.
2. Select "Int. Pwr." from the Power Source list.
3. Select "Out" from the Test Mode list.
4. Connect leads to the mA terminals, as shown in Figure 7.
5. Enter the desired current using either the ARROW keys or the numeric keys.



**Figure 7**  
Connections for Sourcing Current

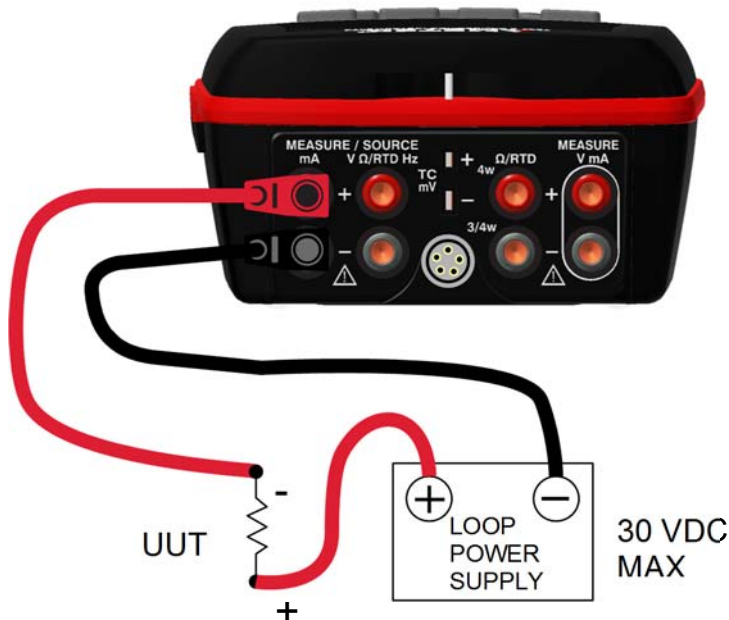
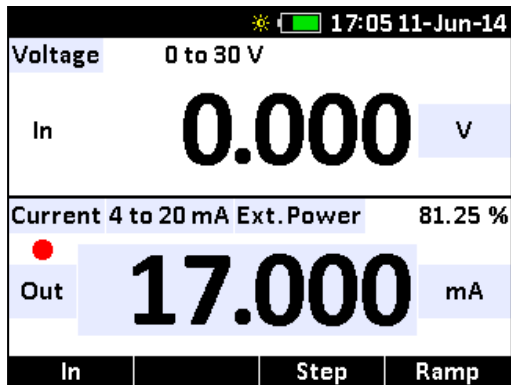
UUT 900 ohms max. (650 ohms with HART resistor turned on)

## 6.2 mA Sink (external loop power supply)

The ASC-400 calibrator can supply a variable test current into a mA loop to calibrate or debug installed mA loops

Follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select "Current" from the Lower Mode list.
2. Select "Ext. Pwr." from the Power Source list.
3. Connect the loop, as shown in Figure 8.



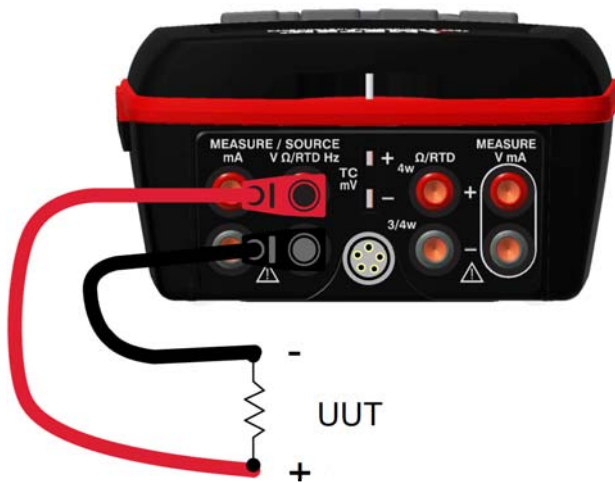
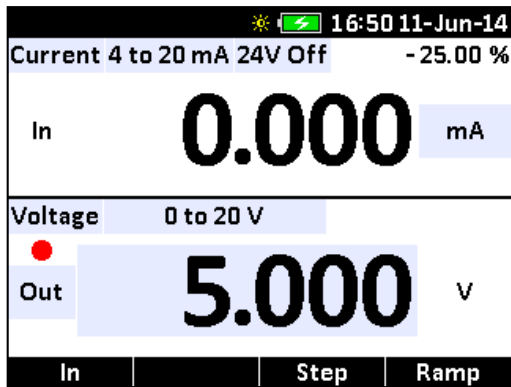
**Figure 8**

Connections for mA loop calibration/debug

## 6.3 Sourcing Voltage

To source voltage, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select “Voltage” from the Lower Mode list.
2. Select “0 to 20 V” from the Range list.
3. Select “Out” from the Test Mode list.
4. Connect leads to the voltage source terminals, as shown in Figure 9.
5. Enter the desired voltage using either the ARROW keys or the numeric keys.

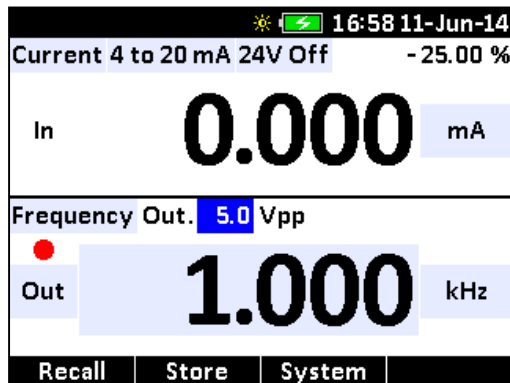


**Figure 9**  
Connections for Sourcing  
Voltage and Frequency

## 6.4 Sourcing Frequency

To source a signal, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select “Frequency” from the Lower Mode list.
1. Select “Out” from the Test Mode list.
2. Select the desired frequency unit from the Units list.
3. Connect leads to the frequency output terminals, as shown in Figure 9.
4. Enter the desired frequency using either the ARROW keys or the numeric keys.
5. The amplitude can be changed by entering the Output Volt peak to peak (Out. Vpp) setup field. Use either the ARROW keys or the numeric keys to change the amplitude.



## 6.5 Sourcing a Pulse Train

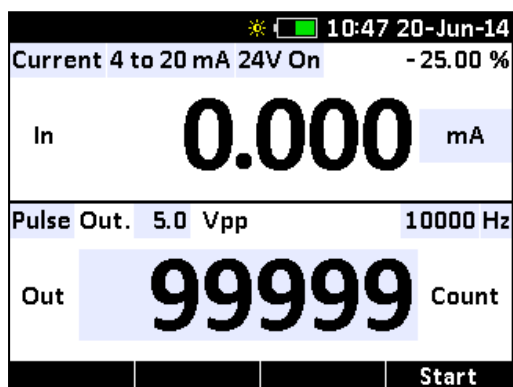
The ASC-400 calibrator can generate a pulse train with a selectable number of pulses at a desired frequency and output level.

For example, setting the frequency to 10Hz and the number of pulses to 99999 would produce 99999 pulses for a period of 10 seconds.

To source a pulse, use the same connection as for frequency, and follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select “Pulse” from the Lower Mode list.
2. Select the desired frequency unit from the Units list.
3. The amplitude of the pulse can be changed by entering the Output (Out. Vpp) setup field. Use either the ARROW keys or the numeric keys to change the amplitude.
4. Enter the desired number of pulses (Count) using either the ARROW keys or the numeric keys.
5. Press **F4** (Start) to start and stop the signal.

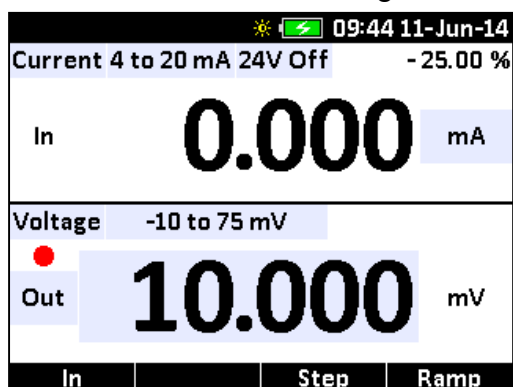




## 6.6 Sourcing mV

To source an mV, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Connect the thermocouple leads to the appropriate polarized TC mini plug, and insert the plug into the TC terminals on the calibrator, as shown in Figure 10.
2. Select “Voltage” from the Lower Mode list.
3. Select “-10 to 75 mV” from the Range list.
4. Select “Out” from the Test Mode list.
5. Enter the desired mV using either the ARROW keys or the numeric keys.



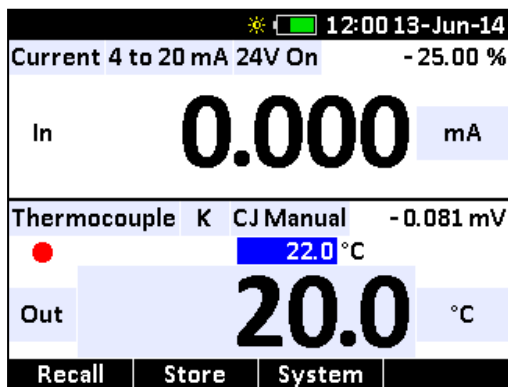
### Note...

CJ compensation is not active in this mode.

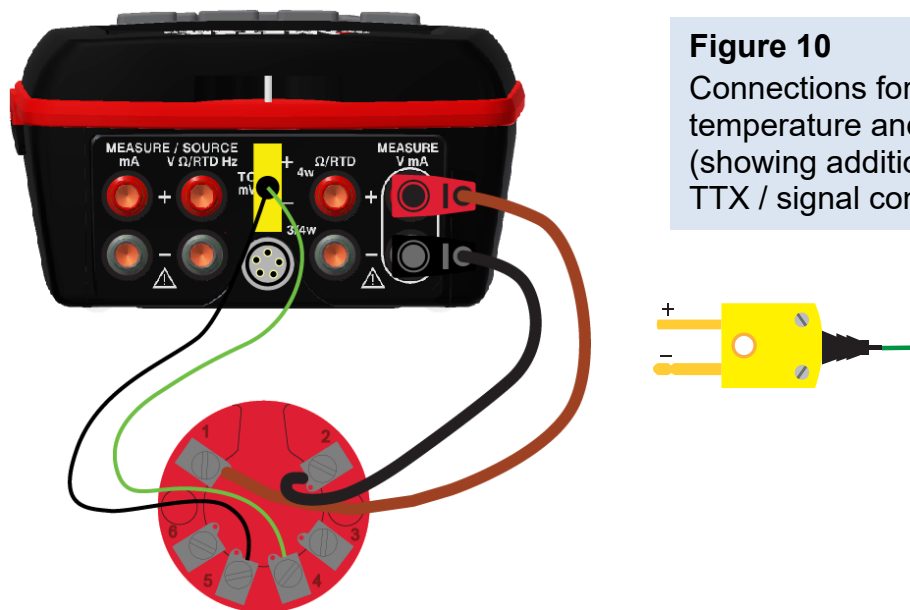
## 6.7 Sourcing Thermocouples

To source a thermocouple, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Connect the thermocouple leads to the appropriate polarized TC mini plug, and insert the plug into the TC terminals on the calibrator, as shown in Figure 10.
2. Select “Thermocouple” from the Lower Mode list.
3. Select the desired thermocouple type from the TC Type list.
4. Select the desired CJ mode from the CJ Mode list.  
If CJ Manual is selected, enter CJ temperature.



5. Select the desired temperature unit from the Units list.
6. Select “Out” from the Test Mode list.
7. Enter the temperature using either the ARROW keys or the numeric keys.



**Figure 10**

Connections for Thermocouple temperature and mV output.  
(showing additional mA loop from TTX / signal converter)



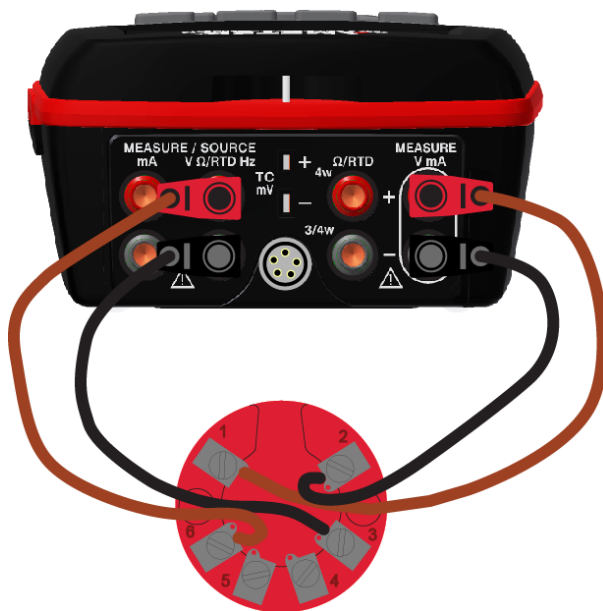
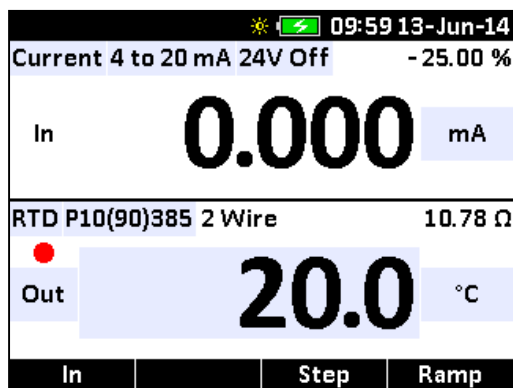
### Note...

The TC wire and connector used must match the TTX / signal converter input

## 6.8 Sourcing Ohms/RTDs

To source an RTD, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select “RTD” or “Resistance” from the Lower Mode list.
2. Select the desired RTD type from the RTD Type list (only when selecting “RTD” from the Lower Mode list).
3. Select the desired temperature unit from the Units list (only when selecting “RTD” from the Lower Mode list).
4. Select “Out” from the Test Mode list.
5. Connect the calibrator to the instrument being tested, as shown in Figure 11.
6. Enter the temperature or the resistance using either the ARROW keys or the numeric keys.



**Figure 11**

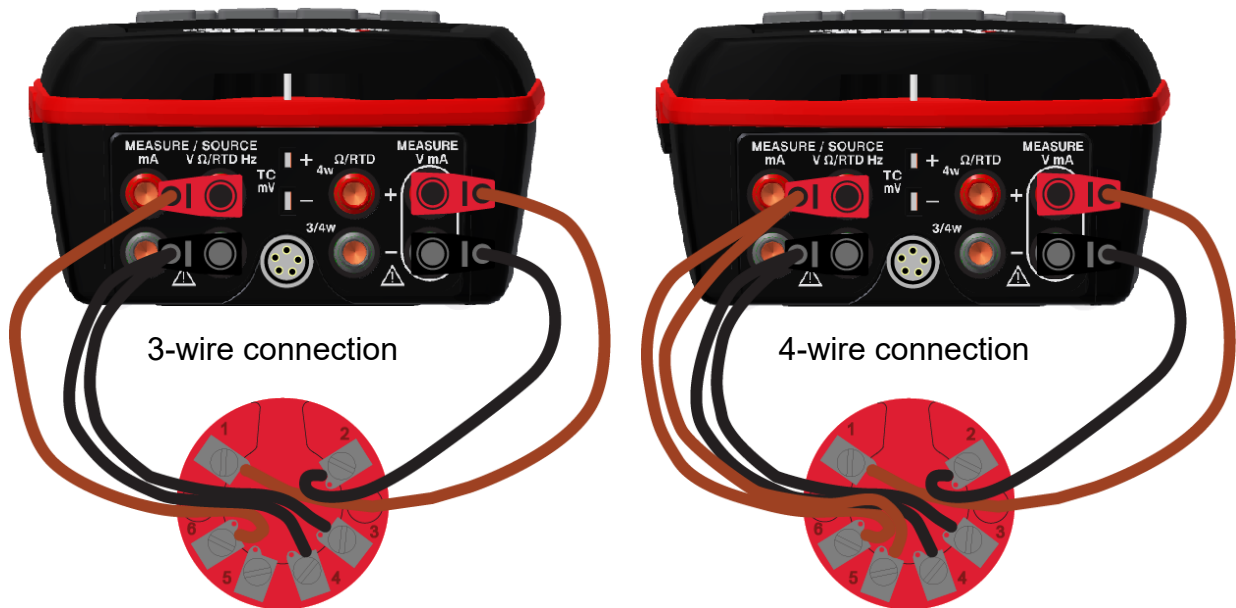
Connections for Outputting RTDs  
(always 2-wire)  
(showing additional mA loop  
from TTX / signal converter)



### Note...

The ASC-400 calibrator simulates a 2-wire RTD. To connect 3- or 4-wire transmitter, use stacked test leads, as shown in Figure 12.

**Figure 12**  
Using a 3- or 4-wire  
Connection for RTDs



## 6.9 Custom RTD

The ASC-400 offers the possibility of entering a custom curve-fit PRT into the calibrator for sourcing and measuring.

Follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select "Custom" from the RTD Type list. The option is found at the bottom of the list.
2. Press **F3** (System) to access the System Settings.

| System Settings            |                          |               |                |
|----------------------------|--------------------------|---------------|----------------|
| Auto Off                   | 30 min.                  | HART Resistor | Off            |
| Date                       | 20 - Jun - 14 Time 15:11 |               |                |
| Custom RTD                 |                          |               |                |
| Min.                       | -203.0 °C                | A             | 3.9083 e - 3   |
| Max.                       | 855.0 °C                 | B             | -5.7750 e - 7  |
| R0                         | 100.00 $\Omega$          | C             | -4.1830 e - 12 |
| User Defined Pressure Unit |                          |               |                |
| Factor                     | 1.00000                  | Offset        | 0.000 PSI      |
| Version 1.04               |                          |               |                |

3. Enter the desired values in the Custom RTD setting fields using either the ARROW keys or the numeric keys and accept the values.
4. Leave the System Settings setup.
5. Attach the custom RTD leads as shown in Figures 11 or 12.

The custom function uses the Calendar-Van Dusen equation for outputting and measuring custom RTDs.

The coefficient C is only used for temperatures below 0°C. Only A and B coefficients are needed for the range above 0°C, so coefficient C should be set to 0.

The R0 is the resistance of the probe at 0°C.

The ITS 90 coefficients for PT385, PT3926, and PT3616 are shown in Table 1.

**Table 1**  
RTD Coefficients

| RTD    | Range (°C) | R0  | Coefficient A           | Coefficient B            | Coefficient C             |
|--------|------------|-----|-------------------------|--------------------------|---------------------------|
| PT385  | -200 to 0  | 100 | $3.9083 \times 10^{-3}$ | $-5.775 \times 10^{-7}$  | $-4.183 \times 10^{-12}$  |
| PT385  | 0 to 850   | 100 | $3.9083 \times 10^{-3}$ | $-5.775 \times 10^{-7}$  | -                         |
| PT3926 | Below 0    | 100 | $3.9848 \times 10^{-3}$ | $-5.87 \times 10^{-7}$   | $-4 \times 10^{-12}$      |
| PT3926 | Above 0    | 100 | $3.9848 \times 10^{-3}$ | $-5.87 \times 10^{-7}$   | -                         |
| PT3916 | Below 0    | 100 | $3.9692 \times 10^{-3}$ | $-5.8495 \times 10^{-7}$ | $-4.2325 \times 10^{-12}$ |
| PT3916 | Above 0    | 100 | $3.9692 \times 10^{-3}$ | $-5.8495 \times 10^{-7}$ | -                         |

## 6.10 Using Auto Output functions

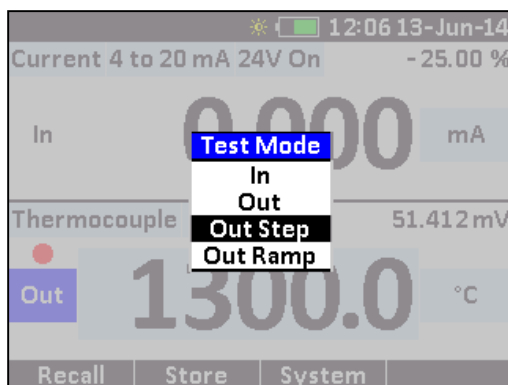
The ASC-400 calibrator has two Auto Output functions:

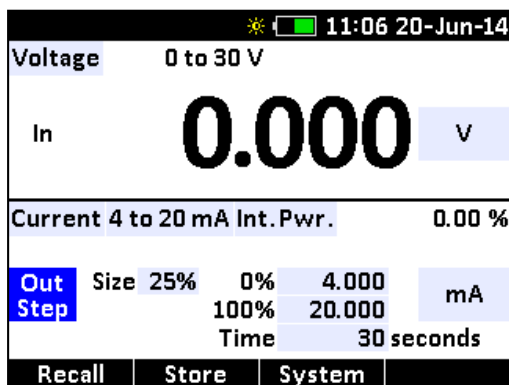
- Step 
- Ramp 

### 6.10.1 Using the Step function

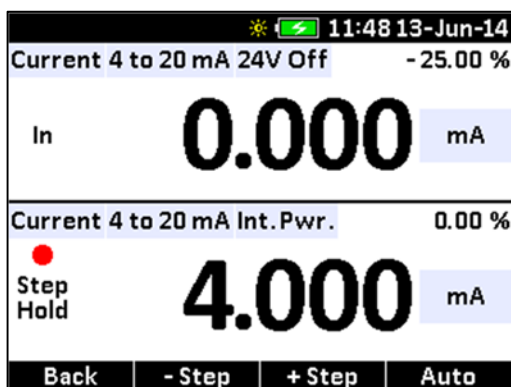
To use the Step function, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select the desired lower mode from the Lower Mode list. Auto Output options are not available for Pulse, Pressure and Baro modes.
2. Select "Out Step" from the Test Mode list.





3. If TC or RTD is selected, choose the type and temperature units first, to get proper step values.
4. Selection of Step is also possible using the **F3** function key (Step) for quick, menu free access.
5. Select the desired step size from the Step Size list. The ASC-400 will step from the 0% set source value to the 100% set source value in 10%, 20% or 25% increments. The step time is adjustable from 1 to 999 seconds.
6. Exit the edit mode menu when all the selections have been made.
7. Press **F3** (Step) to access the MANUAL Step menu.  
or
8. Press **F4** (Auto) to start auto stepping, using the selected step time.

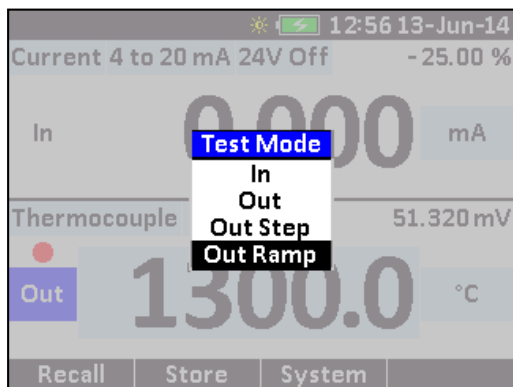


9. Press either **F2** (-Step) or **F3** (+Step) to Step up- or downwards.
10. In AUTO step, press **F4** (Stop) to stop the auto stepping.
11. To cancel Step or Auto step mode, press **F1** (Back).

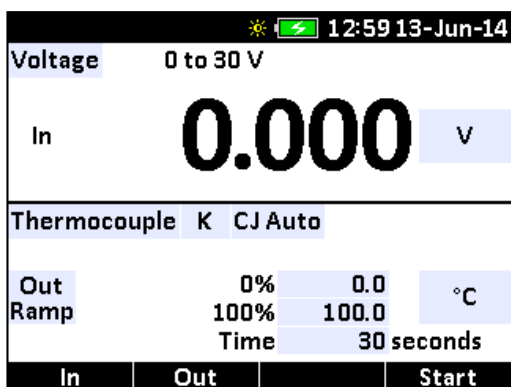
### 6.10.2 Using the Ramp function

To use the Ramp function, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

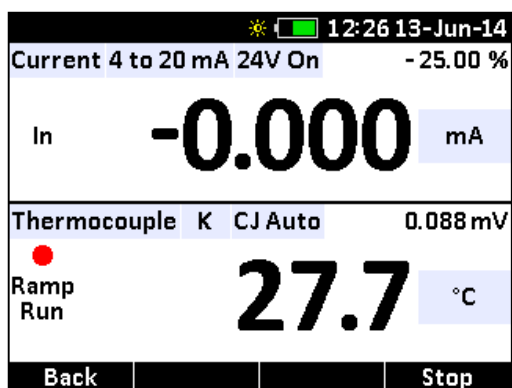
1. Select the desired lower mode from the Lower Mode list. Auto Output options are not available for Pulse, Pressure and Baro modes.
2. Select "Out Ramp" from the Test Mode list.



3. If TC or RTD is selected, choose the type and temperature units first, to get proper ramp values.
4. Selection of Ramp is also possible using the **F4** function key (Ramp) for quick, menu free access.
5. Select the desired 0% and 100% values. The ASC-400 will ramp from the 0% set source value to the 100% set source value in the selected time (5 to 999 seconds).
6. Exit the edit mode menu when all the selections have been made.



7. Press **F4** (Start) to begin auto rapping.



8. When ramping, press **F4** (Stop) to stop ramping.
9. To cancel Ramp mode, press **F1** (Back).

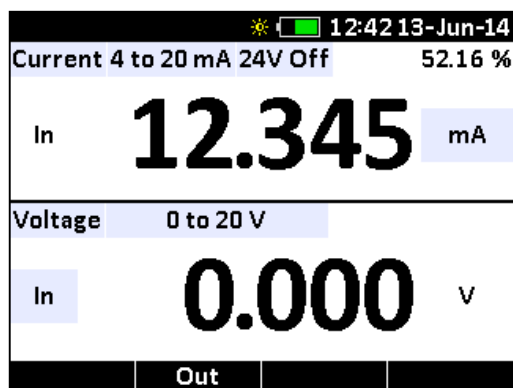
## 7.0 Using Isolated Measure Modes (Upper Display)

### 7.1 Measuring mA (external loop supply)

The current output of a transmitter, or any other 0 to 24 mA current, can be measured using the upper display.

To make the desired measurements, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select “Current” from the Upper Mode list.
2. Select the primary parameters to be measured and accept the selections.



3. Connect the leads to the isolated inputs of the calibrator, as shown in Figure 13.



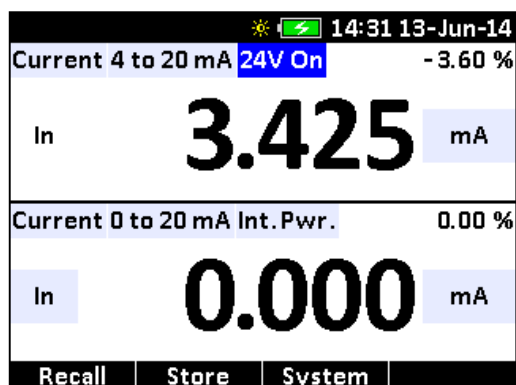
**Figure 13**  
mA current measurement  
connection (upper window)



## 7.2 Measuring current with internal loop power

To test/calibrate a 2-wire, loop powered transmitter, as stand alone, use the loop power function. This function activates a 24V supply in series with the current measuring circuit. To use this option, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select "Current" from the Upper Mode list.
2. Select "24V On" from the 24V Power list.



3. Connect the ASC-400 calibrator to transmitter current loop terminals, as shown in Figure 14.



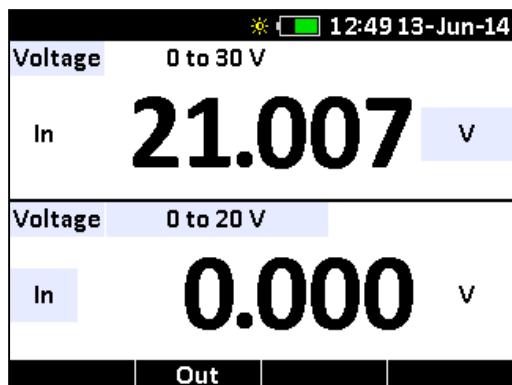
**Figure 14**

Connection using build in loop supply in ASC-400

## 7.3 Measuring Voltage

The voltage output of a transmitter can be measured using the upper display. To make the desired measurements, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select “Voltage” from the Upper Mode list.
2. Select the primary parameters to be measured and accept the selections.



3. Connect the leads to the isolated inputs of the calibrator, as shown in Figure 13.

## 7.4 Measuring Pressure



### Warning

To avoid a violent release of pressure in a pressurized system, shut off the valve and slowly bleed off the pressure before you attach the pressure module to the pressure line.



### Caution...

- To avoid damaging the pressure module from overpressure, never apply pressure above the rated maximum printed on the module.
- To avoid damaging the pressure module from corrosion, use it only with specified materials. Refer to the pressure module documentation for material compatibility.

To measure pressure, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

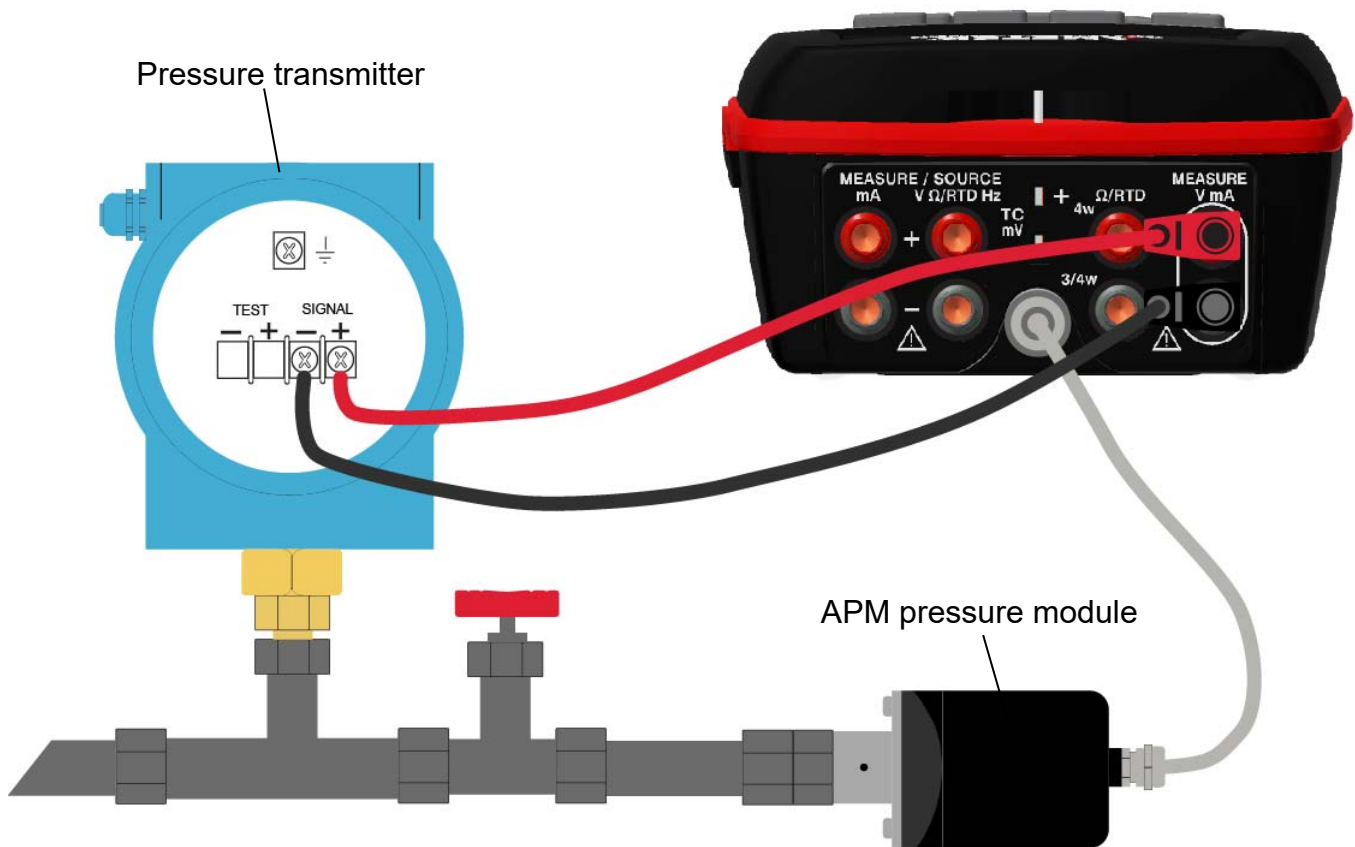
1. Connect the pressure module (JOFRA APM) to the ASC-400 calibrator, as shown in Figure 15.

The calibrator can measure pressure on both the upper and the lower display. This makes it possible to display the pressure value in two different pressure units at the same time.

2. Select either the upper or lower display to work from.
3. Select “Pressure” from the Upper or Lower Mode list.
4. Select the desired measuring unit from the Units list

5. Zero the pressure module (see section 5.5.1 for using the zeroing function).

**Figure 15**  
Measuring on a Pressure Transmitter (PTX)



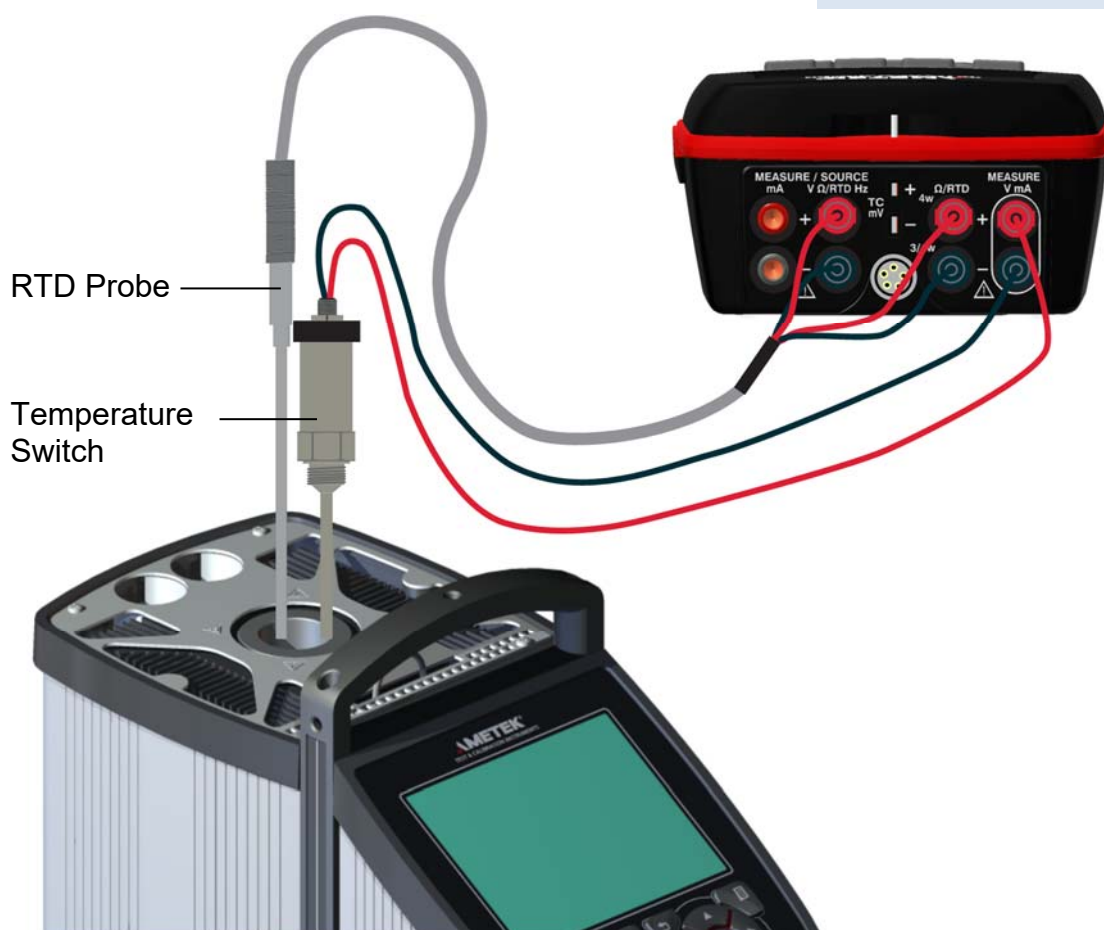
## 8.0 Using the Upper and Lower Display for Calibration and Testing

### 8.1 Performing a Temperature Switch Test

The ASC-400 calibrator can detect switch state changes and link the results in any source/simulate mode (except pulse), performing an automatic or semi automatic switch calibration, on a great variety of pressure, temperature and electrical level switches.

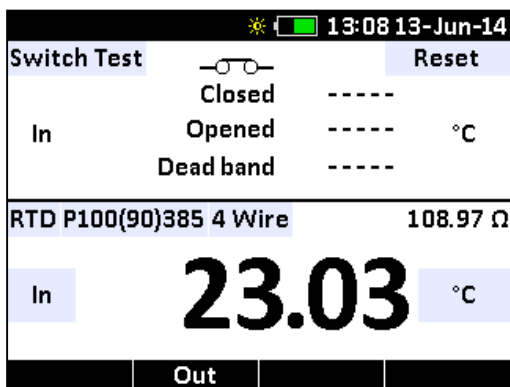
An example is given below for calibrating a temperature switch, measuring the temperature with an external RTD sensor, using an external temperature source.

**Figure 16**  
Temperature Switch Test

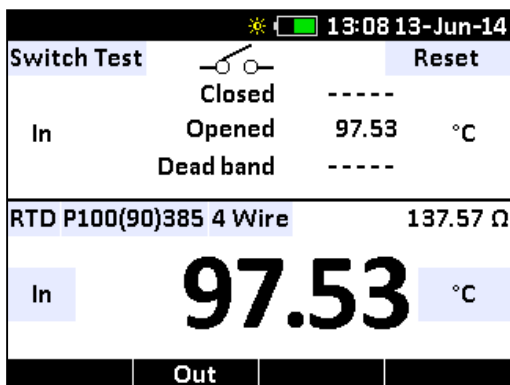


To perform a switch test, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

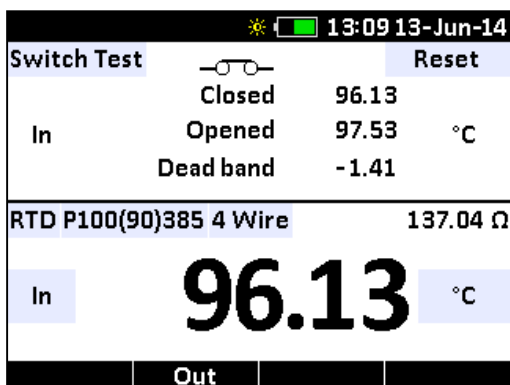
1. Select the upper display and select "Switch Test" from the Upper Mode list.
2. Connect the ASC-400 calibrator to the switch using the switch terminals. The polarity of the terminals does not matter.
3. The upper display shows no read outs at neither "Closed", "Opened" nor "Dead band"



4. Raise the temperature slowly until the switch opens.



5. Lower the temperature slowly until the switch closes.
6. The upper display will now show :
  - the temperature when the switch closed
  - the temperature that the switch opened at
  - the dead band between the temperatures readings.

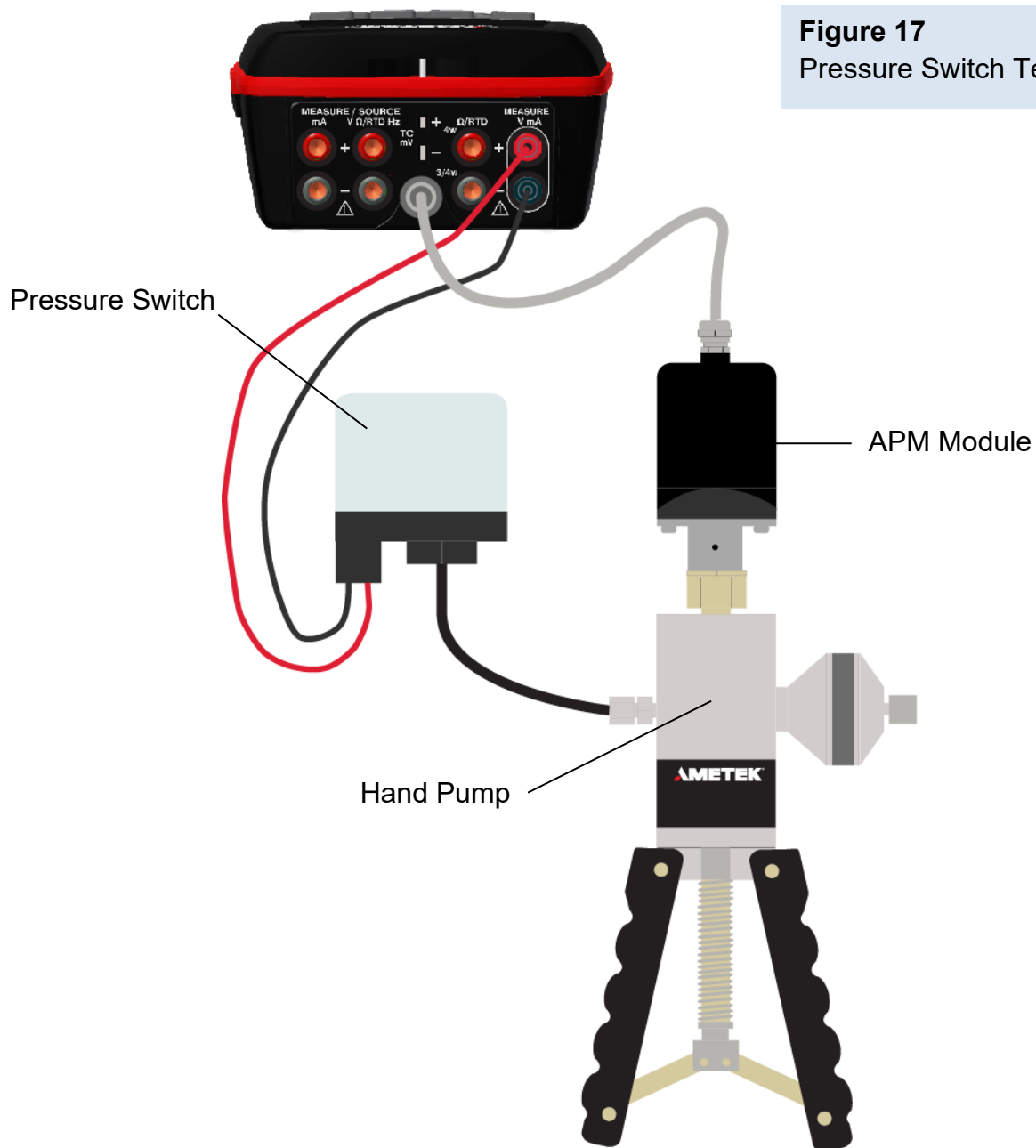


7. To perform another test clear the data by selecting "Reset" using the edit mode.

## 8.2 Performing a Pressure Switch Test

The ASC-400 calibrator can detect contact state changes and capture the results in any source/simulate mode (except pulse). The calibrator records switch state and pressure measurement, at the time of switch change, after the test, the result is displayed in a convenient and easy to use format.

An example is given below for a pressure switch test.



To perform a switch test, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select the upper display and select "Switch Test" from the Upper Mode list.
2. Connect the ASC-400 calibrator to the switch using the pressure switch terminals. The polarity of the terminals does not matter.

3. Connect the pump to the ASC-400 calibrator and the pressure switch.
4. Make sure the vent on the pump is open. Zero the pump if necessary.



### Note...

Zero the APM if necessary. Close the vent after zeroing the calibrator.

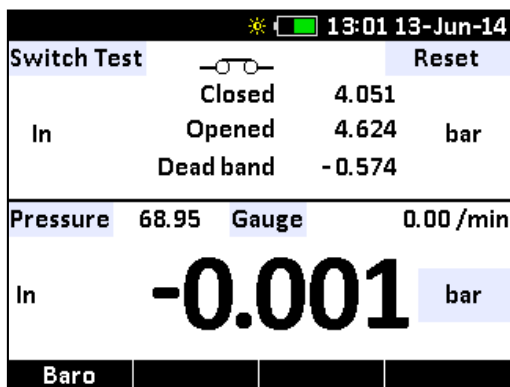
5. The upper display shows no read outs at neither "Closed", "Opened" nor "Dead band"
6. Apply pressure with the pump slowly until the switch opens.



### Note...

In the switch test mode the display update rate is increased to help capture changing pressure inputs. Even with this enhanced sample rate pressurizing device under test should be done slowly to ensure accurate readings.

7. Vent the pump slowly until the pressure switch closes.
8. The upper display will now show :
  - the pressure when the switch closed
  - the pressure that the switch opened at
  - the dead band between the pressure readings.



### 8.3 Testing an Input or Indicating Device

To test and calibrate actuators, recording, and indicating devices using the source functions, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select the lower display and select the desired primary parameter from the Lower Mode list.
2. Select “Out” from the Test Mode list (input/output control).
3. Connect the leads to the device and the ASC-400 calibrator as shown in Figure 18.

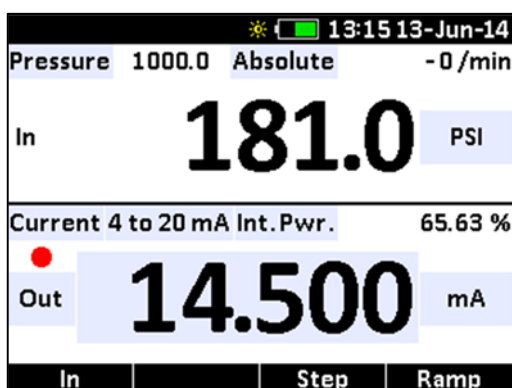


**Figure 18**  
Connections for Testing an Output Device

### 8.4 Calibrating an I/P Device

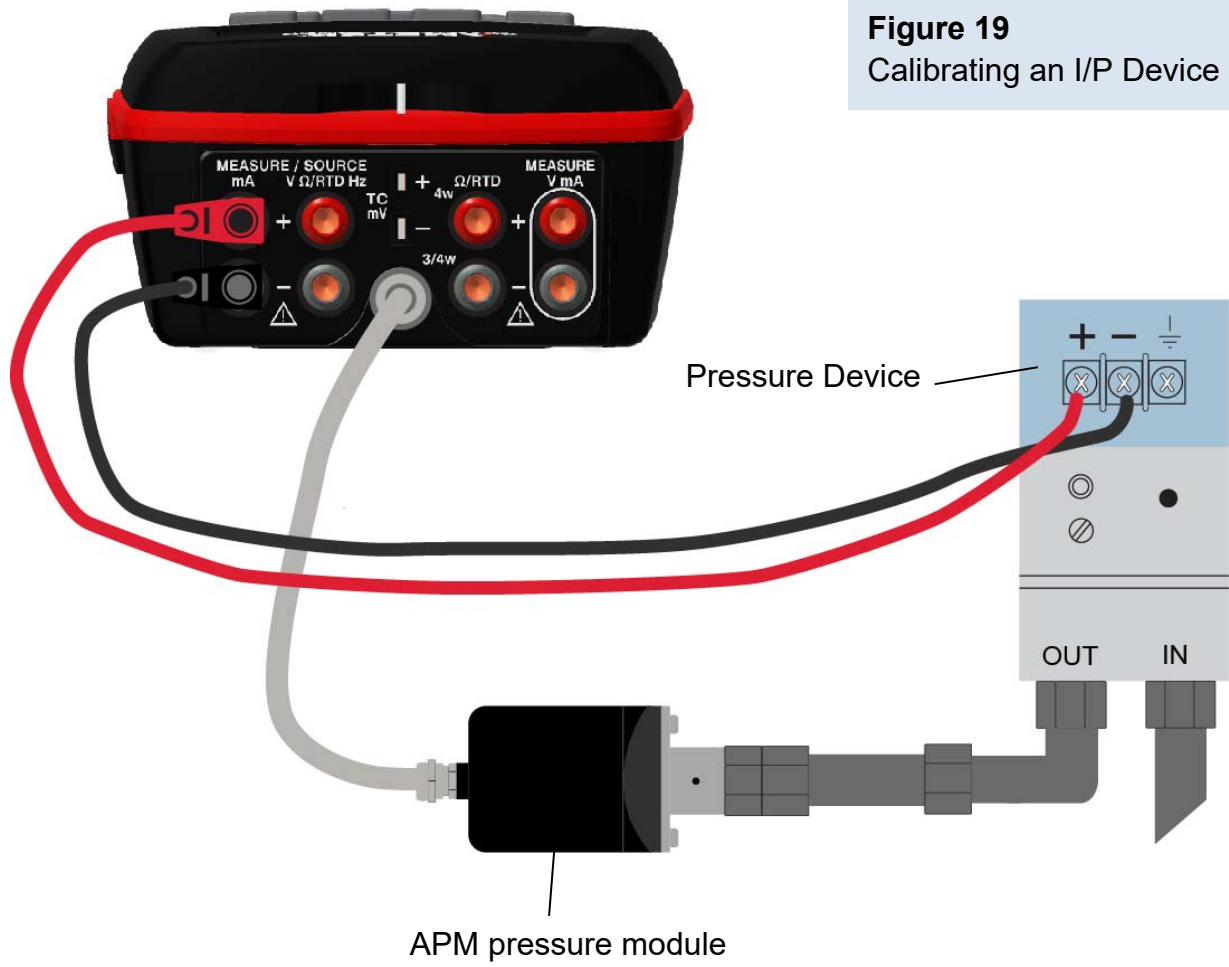
To calibrate a device that controls pressure, follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select the upper display and select “Pressure” from the Upper Mode list.
2. Select the lower display and select “Current” from the Lower Mode list.
3. Connect the ASC-400 calibrator to the device as shown in Figure 19.  
The calibrator will simulate the transmitter current and measure the output pressure.
4. Enter a current using either the ARROW keys or the numeric keys.





**Figure 19**  
Calibrating an I/P Device

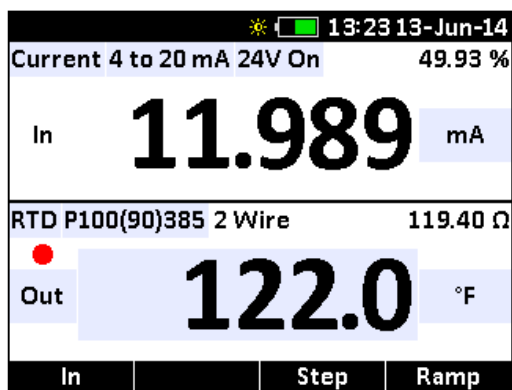


## 8.5 Calibrating a Transmitter (Signal Converter)

To calibrate a transmitter both the upper and the lower displays will be used; one for measuring the output, and one for sourcing the input. This section covers all but the pressure transmitters. A RTD temperature transmitter is used in this example.

Follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select the lower display and select "RTD" from the Lower Mode list.
2. Select "Out" from the Test Mode list (input/output control).
3. Select "RTD" from the RTD Type list.
4. Select the upper display and select "Current" from the Upper Mode list.
5. Select "4 to 20mA" from the Range list.
6. To turn the loop power on, select "24V On" from the 24V Power list (loop power).
7. Connect the ASC-400 calibrator to the transmitter as shown in Figure 20.
8. Enter output values using the numeric keys or fine adjust using the ARROW keys.



9. Adjust the transmitter as necessary.

To calibrate different transmitter types, follow the above steps with the exception of selecting the appropriate input type on the lower display.



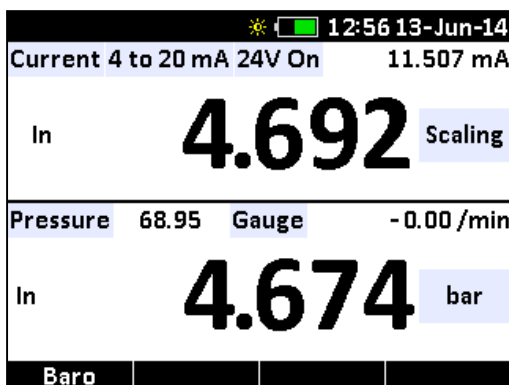
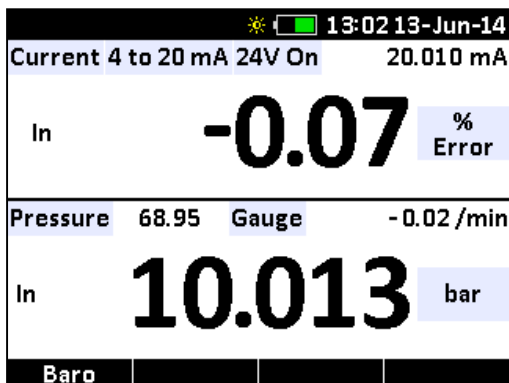
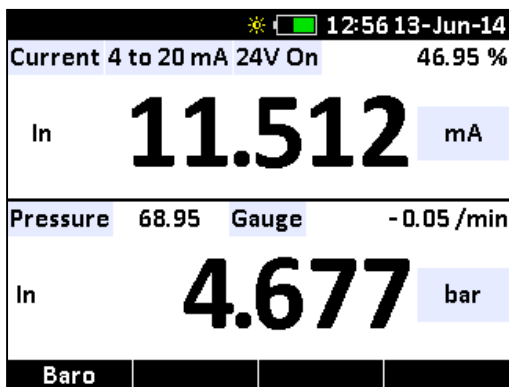
**Figure 20**  
Calibrating a Transmitter

## 8.6 Calibrating a Pressure Transmitter (loop powered 4-20 mA)

To calibrate a pressure transmitter both the upper and the lower displays will be used; upper for measuring the output, and lower for pressure measurement.

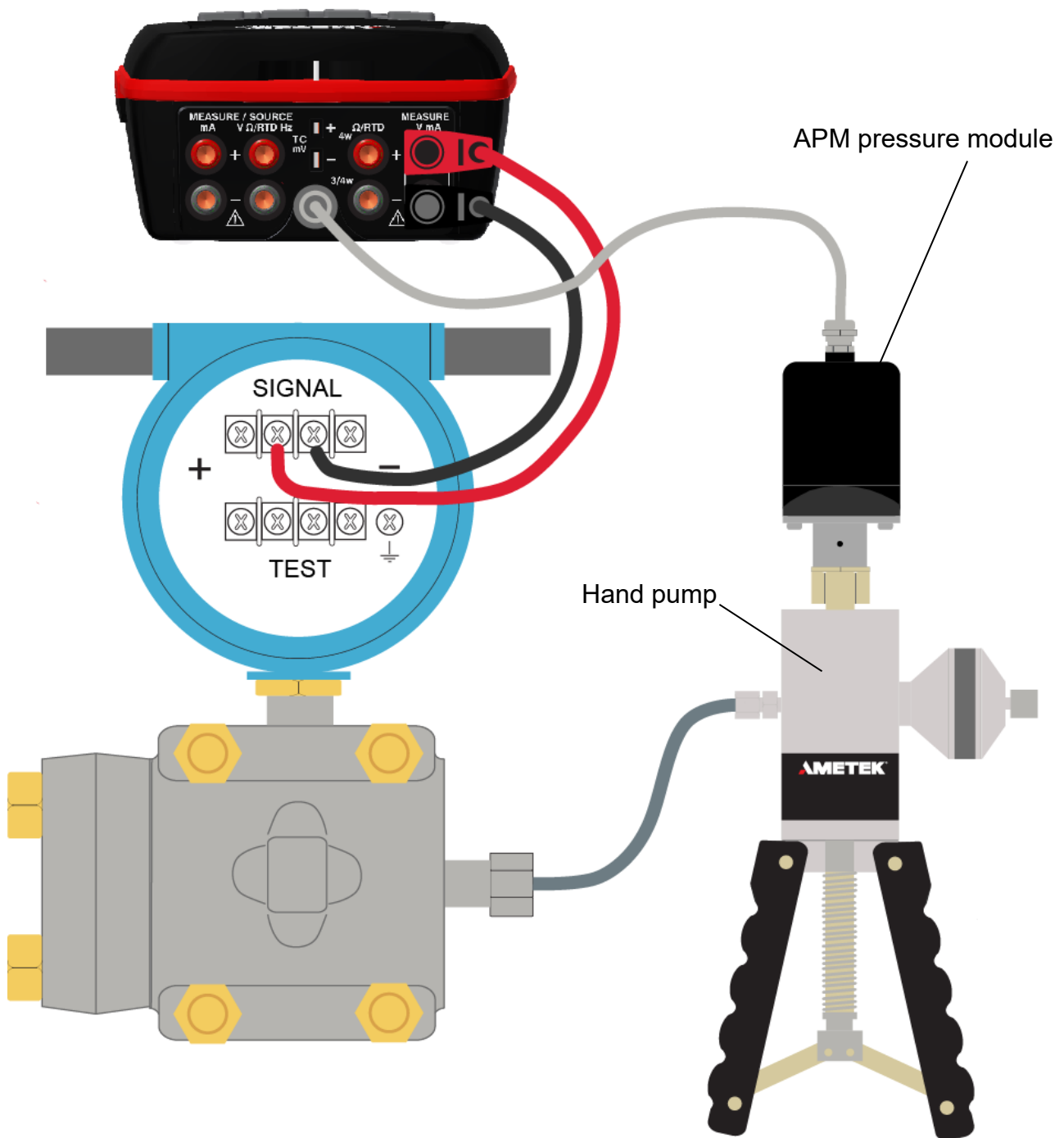
Follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select the lower display and select "Pressure" from the Lower Mode list.
2. Select the upper display and select "Current" from the Upper Mode list.
3. Select "4 to 20mA" from the Range list.
4. To turn the loop power on, select "24V On" from the 24V Power list.
5. Connect the ASC-400 calibrator to the transmitter and the pressure module as shown in Figure 21.
6. Zero the pressure module.



7. Test the transmitter at 3 or more points of the span to prove hysteresis.
8. Adjust the transmitter as necessary.

**Figure 21**  
Calibrating a Pressure Transmitter

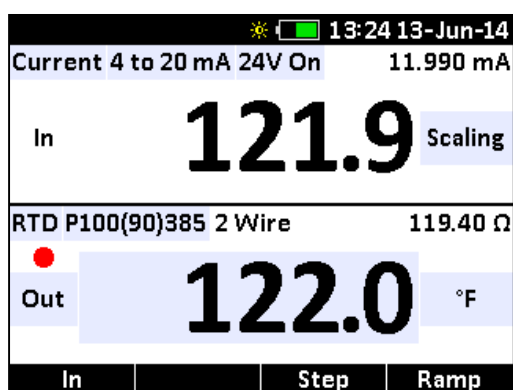
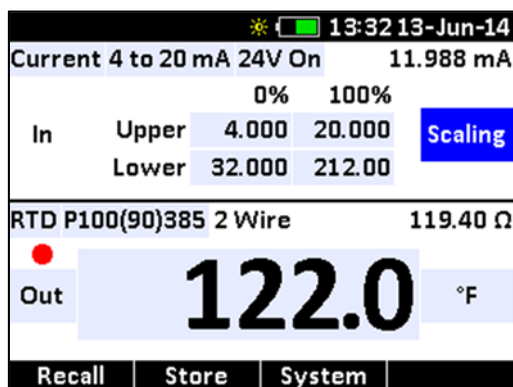


## 8.7 Using Scaled Current or Voltage when testing or calibrating a T/I Transmitter

The ASC-400 calibrator has the ability to read current or voltage on the upper display that is scaled to and displayed in the same units of the lower display.

Follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select the lower display and select “RTD” from the Lower Mode list.
2. Select “Out step” from the Test Mode list (input/output control).
3. Select “RTD” from the RTD Type list.
4. Set the 0%, the 100% span points and the time using either the ARROW keys or the numeric keys
5. Select the upper display and select either “Current” or “Voltage” from the Upper Mode list.
6. Select power mode, internal or external power. (Current only)
7. Select “Scaling” from the Units list.
8. From the Scaling Menu set the 0% and 100% point for the upper and lower displays using either the ARROW keys or the numeric keys.

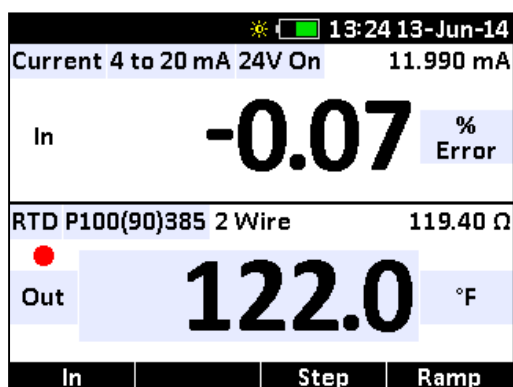
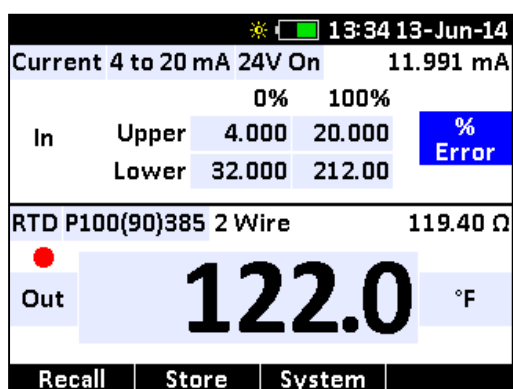


## 8.8 Using Percent Error when testing or calibrating a T/I Transmitter

The ASC-400 calibrator features a function which can calculate signal or pressure vs. milliamp error as a percentage of the 4 to 20 mA loop span.

Follow the principle of navigating through the functions described in the guidelines in section 4.2 and proceed as follows:

1. Select the lower display and select "RTD" from the Lower Mode list.
2. Select "Out step" from the Test Mode list (input/output control).
3. Select "RTD" from the RTD Type list.
4. Set the 0%, the 100% span points and the time using either the ARROW keys or the numeric keys
5. Select the upper display and select either "Current" or "Voltage" from the Upper Mode list.
6. Select power mode, internal or external power. (Current only)
7. Select "%Error" from the Units list.
8. From the %Error Menu set the 0% and 100% point for the upper and lower displays using either the ARROW keys or the numeric keys.



## 9.0 Maintenance

---



### Warning

To avoid possible electric shock, personal injury or sudden release of pressure, review “Safety Instructions” Section 2.0 before proceeding.

Only qualified service personnel should perform calibration, repairs, or service not covered by this manual.

For maintenance procedures not described in this manual, or if the ASC-400 calibrator needs repair, please contact AMETEK Denmark Service Department as described below in section 9.1 “Returning the calibrator to service”.

### 9.1 Returning the calibrator to service

If the calibrator continuously malfunctions, verify that the instrument is being operated as described in this manual and return it to the manufacturer for repair/service.

If the calibrator needs repair and is under warranty, see the warranty statement section 1.1 for terms. If the warranty has lapsed, the calibrator can be repaired and returned for a fixed fee.

When returning the instrument please enclose a fully completed service information form. Simply copy the “Service info” form from the following page and fill in the required information. The calibrator should be returned in the original packing.



### Note...

AMETEK Denmark’s liability ceases if:

- parts are replaced/repared using spare parts, which are not identical to those recommended by the manufacturer.
- non-original parts are used in any way when operating the instrument.

AMETEK Denmark’s liability is restricted to errors originated from the factory.

# Service info

## Customer data:

Date:

Customer name and address: \_\_\_\_\_

Attention and dept.: \_\_\_\_\_

Fax no./phone no.: \_\_\_\_\_

Your order no.: \_\_\_\_\_

Delivery address: \_\_\_\_\_

Distributor name: \_\_\_\_\_

## Instrument data:

Model and serial no.: \_\_\_\_\_

Warranty claimed Yes: \_\_\_\_\_ No: \_\_\_\_\_ Original invoice no.: \_\_\_\_\_

Temp.  
calibration

Sensor  
input

### Service request:

This instrument is sent for  
(please check off):

☐☐

\_\_\_ Calibration as left

\_\_\_ Check

☐☐

\_\_\_ Calibration as found and as left

\_\_\_ Service

☐☐

\_\_\_ Accredited calibration as left

\_\_\_ Repair

☐☐

\_\_\_ Accredited calibration as found and as left.

## Diagnosis data/cause for return:

Diagnosis/fault description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Special requests: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Safety precautions:** if the product has been exposed to any hazardous substances, it must be thoroughly decontaminated before it is returned to AMETEK Denmark A/S. Details of the hazardous substances and any precautions to be taken must be enclosed.



## 9.2 Replacing batteries

The battery icon  indicates how much power is remaining.

If the batteries discharge too deeply the calibrator will automatically shut down to avoid battery leakage and false measurements.

All stored data will be preserved.



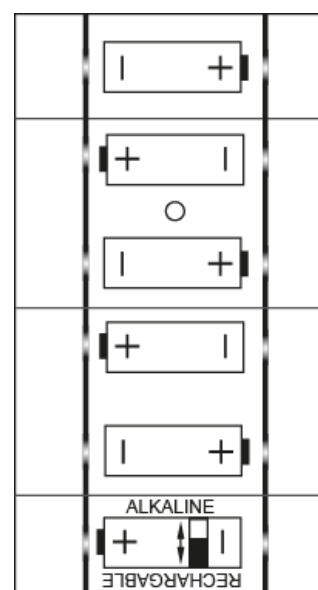
### Caution...

**Always** set the charger switch in “Alkaline” position when alkaline batteries are installed (factory setting).

The ASC-400 calibrator uses six AA batteries.

1. Unscrew the captive screw to gain access to the battery compartment.

**Figure 22**  
Replacing batteries



2. Replace the batteries taking care to note polarity for their proper installation. Use **ONLY** AA size Alkaline batteries or optional NiMH rechargeable batteries. Ensure the battery type switch is in the right position (Alkaline or rechargeable).



Position for  
Alkaline  
batteries



Position for  
Rechargeable  
batteries

3. Remount battery cover and the captive screw.

## 9.3 Storing

It is not necessary to store away the ASC-400 calibrator after use.

The calibrator can be part of a continuous set-up, as long as it is kept in a dry, clean place.

Alternatively the calibrator can be stored in the soft bag delivered with the instrument.

## 9.4 Cleaning



### Caution...

Before cleaning the calibrator, you **must** switch it off.

Periodically wipe the case of the calibrator with a damp soft cloth. A mild detergent can be used with the water.



### Caution...

- The soft cloth must be firmly wrung to avoid any water penetrating the calibrator and causing damage.
- **Do not** use solvents or abrasive cleansers. They might damage the display and case.

## 10.0 Errors



### Warning

During set-up, make sure that there is correlation between the software set-up, and the actual distribution of the sensors connected to the calibrator. The software cannot detect misplacements of sensors.

If the power is lost to the entire test set-up or part of it, it is highly recommended to restart the calibration.

| GENERAL ERRORS                     |  |
|------------------------------------|--|
| Error description                  | Solution   |
| ASC-400 does not turn on :         | <ul style="list-style-type: none"><li>• Check the batteries</li><li>• Check the power supply</li><li>• If the error still occurs, return the ASC-400 to the manufacturer for service</li></ul>   |
| Faulty readout :                   | <ul style="list-style-type: none"><li>• Check that the connected sensors are correctly connected and that they are properly polarised</li><li>• Check that the ASC-400 is set up correctly</li><li>• Switch the ASC-400 off and on again</li><li>• If the error still occurs, return the ASC-400 to the manufacturer for service</li></ul>   |
| No contact with the ASC-400 :      | <ul style="list-style-type: none"><li>• Check the power supply</li><li>• Check the USB connection. Use only the supplied cable</li><li>• Switch the ASC-400 off and on again - and set up the software again</li><li>• If the error still occurs, return the ASC-400 to the manufacturer for service</li></ul>   |
|                                    | When using Hyper Terminal or similar terminal programs, and communications fails, check that the program has been set up correctly.  |
| Faulty readout from thermocouples: | <ul style="list-style-type: none"><li>• Check that the correct type has been selected during setup</li><li>• Check that the sensors have been correctly polarised and connected</li><li>• Check that the correct type of cold junction has been selected manually/automatically/off</li><li>• Check that the ASC-400 is not subjected to direct or indirect heat sources</li></ul> |

## 11.0 Technical specifications

All specifications are given with an ambient temperature of  $23 \pm 5^{\circ}\text{C}$  /  $73 \pm 9^{\circ}\text{F}$

### Mechanical specifications

| Description                             | Value   |
|---|---|
| Operating temperature :                 | -10 to $50^{\circ}\text{C}$ / 14 to $122^{\circ}\text{F}$ |
| Storage temperature :                   | -20 to $60^{\circ}\text{C}$ / -4 to $140^{\circ}\text{F}$ |
| Dimension LxWxH :                       | 220x96x55 mm / 8.66x3.78x2.17 in                          |
| Case protection:                        | IP40  |
| Humidity:                               | 0% to 80% R.H. non-condensing                             |
| Display:                                | 2.8" 320*240 TFT colour display                           |
| Weight incl. Batteries :                | 584 g / 20.6 oz   |
| Unit in soft case :                     | 235x95x115 mm / 9.25x3.74x4.53 in                         |
| Weight incl. Test leas and test chips : | 933 g / 32.91 oz  |
| Shipping size :                         | 275x100x175 mm / 10.83x3.94x6.89 in                       |
| Shipping weight :                       | 1233 g / 43.49 oz   |

### Electrical specifications

| Description  | Value   |
|--|---|
| Mains adapter:   | (option) 9VDC/500mA - 230VAC/115VAC   |
| Batteries :  | 6 x AA batteries<br>1.5V AA... Alkaline (non rechargeable) or AA NiMH (rechargeable)  |
| Battery lifetime, Alkaline, backlight low:                                       | 30 hours  |
| Battery lifetime, Alkaline, backlight high, 12 mA: loop power:                   | 13 hours  |
| Battery charge current. Use only NiMH cells with capacity larger than 1700 mAh.: | 85 mA   |
| RS232 communication interface :  |   |
| Connector :  | Mini USB female (B)   |
| Communication type :   | USB 2.0 / ASCII   |
| Display update rate:   | 2.5/second (mA, V, resistance, RTD, TC)<br>10/second (pressure, switch-test)  |
| Temperature coefficient:<br>-10°C to 18°C and 28°C to 50°C:                      | 0.003%FS/°C / 0.0017%FS/°F (mA, V, resistance)<br>0.001%rdg/°C / 0.0006%rdg/°F (frequency)  |
| Electromagnetic environment:   | The ASC-400 is designed for use in basic electromagnetic environment as defined in EN61326-1 2013 and has been tested in typical configurations using the supplied external power supply, USB cable and test cables for device under test. Length of test cables should not exceed 3 m. |

| Thermocouple mV | Range      |           | Accuracy $\pm$<br>12 months  |
|-----------------|------------|-----------|------------------------------|
|                 | Min        | Max       |                              |
| TC mV read      | -10.000 mV | 75.000 mV | 0.015% rdg +10 $\mu\text{V}$ |
| TC mV source    | -10.000 mV | 75.000 mV | 0.015% rdg +10 $\mu\text{V}$ |

Maximum output current is 3 mA Output impedance 0.010 ohm. Input impedance 10 Mohm.

| Thermocouple Cold junction | Range       |             | Accuracy ±             |
|----------------------------|-------------|-------------|------------------------|
|                            | Min         | Max         | 12 months              |
| CJC compensation           | 18°C / 64°F | 28°C / 83°F | 0.2°C / 0.36°F         |
| CJC outside above          |             |             | 0.05°C/°C<br>0.05°F/°F |

| Volt V              | Range   |          | Accuracy ±     |
|---------------------|---------|----------|----------------|
|                     | Min     | Max      | 12 months      |
| Read (Isolated)     | 0.000 V | 30.000 V | 0.01% rdg +2mV |
| Read (non-isolated) | 0.000 V | 20.000 V | 0.01% rdg +2mV |
| Source              | 0.000 V | 20.000 V | 0.01% rdg +2mV |

Maximum output current in voltage ranges is 3 mA Output impedance <1 ohm . Input resistance 1 Mohm.

| Frequency Pulse                             | Range  |        | Accuracy ±          |
|---|--------|--------|---------------------|
|   | Min    | Max    | 12 months           |
| CPM read                                    | 2.0    | 600.0  | 0.05% rdg + 0.1CPM  |
| Hz read                                     | 0.050  | 10.000 | 0.05% rdg + 0.001Hz |
|   | 10.000 | 100.00 | 0.05% rdg + 0.01Hz  |
|   | 100.00 | 1000.0 | 0.05% rdg + 0.1Hz   |
|   | 1000.0 | 10000  | 0.05% rdg + 1Hz     |
| KHz read                                    | 1.000  | 10.000 | 0.05% rdg +0.001KHz |
| CPM source                                  | 2.0    | 600.0  | 0.05% rdg           |
| Hz source                                   | 0.050  | 1000.0 | 0.05% rdg           |
|   | 1000.0 | 10000  | 0.06% rdg           |
| KHz source                                  | 1.000  | 10.000 | 0.06% rdg           |
| Pulse (source only)<br>Rate : 1 Hz to 10KHz | 1      | 99999  |                     |

Input voltage amplitude range on frequency is 1 to 20 V, Trigger level 0.2 to 10 volt. Minimum pulse width 10 µS. Output amplitude is adjustable from 1 to 20 V and is a square wave with a 50% duty cycle. For output frequency, a slight negative offset of approximately -0.1 V is present to assure zero crossing.

| Ohm   | Range |        | Accuracy ±            |
|---|-------|--------|-----------------------|
|   | Min   | Max    | 12 months             |
| Ohm read (low)  | 0.00  | 400.00 | 0.015% rdg + 0.03 ohm |
| Ohm read (high)   | 400.0 | 4000.0 | 0.015% rdg + 0.3 ohm  |
| Ohm source (low)<br>@ 0.1 to 0.2 mA<br>@ 0.2 to 0.5 mA<br>@ 0.5 to IE max | 5.0   | 400.00 | 0.015% rdg +0.10 ohm  |
|   | 5.0   | 400.00 | 0.015% rdg +0.05 ohm  |
|   | 5.0   | 400.00 | 0.015% rdg +0.03 ohm  |
| Ohm source (high)<br>@ 0.05 to 0.1 mA<br>@ 0.1 to IE max                  | 400.0 | 4000.0 | 0.015% rdg +0.5 ohm   |
|   | 400.0 | 4000.0 | 0.015% rdg +0.3 ohm   |

True Ohm Measurement current (pulsed) 0.25 mA.

3W measurement current match 1% Source excitation current IEXI(max) = 2.0 V / R, IEXI must never exceed 3 mA.

Pulsed current (source) Unit is compatible with smart transmitters and PLCs with pulse > 5 ms.

## Current – mA and loop

| Description | Value |
|-------------|-------|
|-------------|-------|

|           |            |
|-----------|------------|
| Range mA: | 0 to 24 mA |
|-----------|------------|

|                             |                          |
|-----------------------------|--------------------------|
| Loop power for transmitter: | Yes, 24 VDC / $\pm 10\%$ |
|-----------------------------|--------------------------|

|                 |     |
|-----------------|-----|
| Isolated input: | Yes |
|-----------------|-----|

| Current mA          | Range    |           | Accuracy $\pm$<br>12 months |
|---------------------|----------|-----------|-----------------------------|
|                     | Min      | Max       |                             |
| Read (Isolated)     | 0.000 mA | 24.000 mA | 0.010% rdg +2 $\mu$ A       |
| Read (non-isolated) | 0.000 mA | 24.000 mA | 0.010% rdg +2 $\mu$ A       |
| Source              | 0.000 mA | 24.000 mA | 0.010% rdg +2 $\mu$ A       |

Hart resistor 250 ohm (On/Off in software). Maximum loop resistance source @ 24 mA (Hart on/ Hart off) 650 ohm / 900 ohm.

mA source voltage input range (external power/HART resistor off) 1V - 30V.

## Thermocouple - TC

Description

Value

TC types:

B, BP, C, E, J, K, L, N, R, S, T, U, XK

Cold junction compensation ON/OFF

Control:

Yes

| TC Type | Temperature resolution |         | Temperature range |        |      |         | 12 month accuracy |      |
|---------|------------------------|---------|-------------------|--------|------|---------|-------------------|------|
|         | Source                 | Measure | °C                |        | °F   |         | °C                | °F   |
|         |                        |         | Min.              | Max.   | Min. | Max.    |                   |      |
| B       | 0,1                    | 0,1     | 250               | 300    | 482  | 572     | 4,02              | 7,24 |
|         |                        |         | 300               | 400    | 572  | 752     | 3,36              | 6,05 |
|         |                        |         | 400               | 600    | 752  | 1112    | 2,47              | 4,45 |
|         |                        |         | 600               | 800    | 1112 | 1472    | 1,60              | 2,88 |
|         |                        |         | 800               | 1000   | 1472 | 1832    | 1,39              | 2,51 |
|         |                        |         | 1000              | 1820   | 1832 | 3308    | 1,07              | 1,93 |
| BP      | 0,1                    | 0,1     | 0                 | 1200   | 32   | 2192    | 0,89              | 1,61 |
|         |                        |         | 1200              | 2000   | 2192 | 3632    | 1,39              | 2,51 |
|         |                        |         | 2000              | 2500   | 3632 | 4532    | 1,96              | 3,53 |
| C       | 0,1                    | 0,1     | 0                 | 200    | 32   | 392     | 0,75              | 1,35 |
|         |                        |         | 200               | 800    | 392  | 1472    | 0,64              | 1,16 |
|         |                        |         | 800               | 1200   | 1472 | 2192    | 0,78              | 1,41 |
|         |                        |         | 1200              | 1600   | 2192 | 2912    | 0,97              | 1,75 |
|         |                        |         | 1600              | 2000   | 2912 | 3632    | 1,24              | 2,24 |
|         |                        |         | 2000              | 2316   | 3632 | 4200,8  | 1,70              | 3,06 |
| E       | 0,1                    | 0,01    | -200              | -100   | -328 | -148    | 0,46              | 0,83 |
|         |                        |         | -100              | 0      | -148 | 32      | 0,26              | 0,47 |
|         |                        |         | 0                 | 400    | 32   | 752     | 0,20              | 0,36 |
|         |                        |         | 400               | 1000   | 752  | 1832    | 0,30              | 0,54 |
| J       | 0,1                    | 0,01    | -210              | -150   | -346 | -238    | 0,59              | 1,07 |
|         |                        |         | -150              | 0      | -238 | 32      | 0,34              | 0,62 |
|         |                        |         | 0                 | 660    | 32   | 1220    | 0,26              | 0,47 |
|         |                        |         | 660               | 1200   | 1220 | 2192    | 0,36              | 0,65 |
| K       | 0,1                    | 0,01    | -200              | -100   | -328 | -148    | 0,72              | 1,30 |
|         |                        |         | -100              | 0      | -148 | 32      | 0,35              | 0,63 |
|         |                        |         | 0                 | 400    | 32   | 752     | 0,30              | 0,54 |
|         |                        |         | 400               | 800    | 752  | 1472    | 0,37              | 0,67 |
|         |                        |         | 800               | 1000   | 1472 | 1832    | 0,42              | 0,76 |
|         |                        |         | 1000              | 1372   | 1832 | 2501,6  | 0,53              | 0,96 |
| L       | 0,1                    | 0,01    | -200              | -100   | -328 | -148    | 0,37              | 0,67 |
|         |                        |         | -100              | 900    | -148 | 1652    | 0,26              | 0,47 |
| N       | 0,1                    | 0,01    | -200              | -100   | -328 | -148    | 1,08              | 1,95 |
|         |                        |         | -100              | 0      | -148 | 32      | 0,50              | 0,90 |
|         |                        |         | 0                 | 1000   | 32   | 1832    | 0,41              | 0,74 |
|         |                        |         | 1000              | 1300   | 1832 | 2372    | 0,49              | 0,89 |
| R       | 0,1                    | 0,1     | -50               | 0      | -58  | 32      | 2,72              | 4,90 |
|         |                        |         | 0                 | 200    | 32   | 392     | 1,89              | 3,41 |
|         |                        |         | 200               | 660    | 392  | 1220    | 1,17              | 2,11 |
|         |                        |         | 660               | 1600   | 1220 | 2912    | 0,95              | 1,71 |
|         |                        |         | 1600              | 1768,1 | 2912 | 3214,58 | 1,07              | 1,93 |
| S       | 0,1                    | 0,1     | -50               | 0      | -58  | 32      | 2,51              | 4,52 |
|         |                        |         | 0                 | 200    | 32   | 392     | 1,86              | 3,35 |
|         |                        |         | 200               | 400    | 392  | 752     | 1,21              | 2,18 |
|         |                        |         | 400               | 1600   | 752  | 2912    | 1,10              | 1,98 |
|         |                        |         | 1600              | 1768,1 | 2912 | 3214,58 | 1,23              | 2,22 |
| T       | 0,1                    | 0,01    | -200              | -100   | -328 | -148    | 0,70              | 1,26 |
|         |                        |         | -100              | 0      | -148 | 32      | 0,38              | 0,69 |
|         |                        |         | 0                 | 200    | 32   | 392     | 0,26              | 0,47 |

|           |     |      |      |      |      |      |      |      |
|-----------|-----|------|------|------|------|------|------|------|
|           |     |      | 200  | 400  | 392  | 752  | 0,22 | 0,40 |
| <b>U</b>  | 0,1 | 0,01 | -200 | 0    | -328 | 32   | 0,54 | 0,98 |
|           |     |      | 0    | 600  | 32   | 1112 | 0,26 | 0,47 |
| <b>XK</b> | 0,1 | 0,01 | -200 | -100 | -328 | -148 | 0,43 | 0,78 |
|           |     |      | -100 | 0    | -148 | 32   | 0,23 | 0,42 |
|           |     |      | 0    | 400  | 32   | 752  | 0,18 | 0,33 |
|           |     |      | 400  | 800  | 752  | 1472 | 0,24 | 0,44 |

Does not include thermocouple wire error and CJC.



## Resistance - RTD

### Description

### Value

#### RTD types:

Pt10/50/100/200/400/500/1000, Cu10/50/100, Ni120, YSI400

#### Response time:

Less than 5 mSec

#### Connection:

2, 3 and 4-wire

| 4-wire RTD Type | Temperature resolution |         | Temperature range |      |      |      | 12 month accuracy |      |
|-----------------|------------------------|---------|-------------------|------|------|------|-------------------|------|
|                 | Source                 | Measure | °C                |      | °F   |      | °C                | °F   |
|                 |                        |         | Min.              | Max. | Min. | Max. |                   |      |
| Pt10(90)385     | 0,1                    | 0,1     | -200              | 100  | -328 | 212  | 0,85              | 1,53 |
|                 |                        |         | 100               | 400  | 212  | 752  | 0,98              | 1,77 |
|                 |                        |         | 400               | 660  | 752  | 1220 | 1,12              | 2,02 |
|                 |                        |         | 660               | 850  | 1220 | 1562 | 1,23              | 2,22 |
| Pt50(90)385     | 0,1                    | 0,01    | -200              | 100  | -328 | 212  | 0,22              | 0,4  |
|                 |                        |         | 100               | 400  | 212  | 752  | 0,29              | 0,53 |
|                 |                        |         | 400               | 660  | 752  | 1220 | 0,35              | 0,63 |
|                 |                        |         | 660               | 850  | 1220 | 1562 | 0,41              | 0,74 |
| Pt100(90)385    | 0,1                    | 0,01    | -200              | 100  | -328 | 212  | 0,12              | 0,22 |
|                 |                        |         | 100               | 400  | 212  | 752  | 0,2               | 0,36 |
|                 |                        |         | 400               | 660  | 752  | 1220 | 0,26              | 0,47 |
|                 |                        |         | 660               | 850  | 1220 | 1562 | 0,31              | 0,56 |
| Pt200(90)385    | 0,1                    | 0,01    | -200              | 265  | -328 | 509  | 0,14              | 0,26 |
|                 |                        |         | 265               | 400  | 509  | 752  | 0,55              | 0,99 |
|                 |                        |         | 400               | 660  | 752  | 1220 | 0,64              | 1,16 |
|                 |                        |         | 660               | 850  | 1220 | 1562 | 0,72              | 1,3  |
| Pt400(90)385    | 0,1                    | 0,01    | -200              | 0    | -328 | 32   | 0,09              | 0,17 |
|                 |                        |         | 0                 | 400  | 32   | 752  | 0,34              | 0,62 |
|                 |                        |         | 400               | 660  | 752  | 1220 | 0,41              | 0,74 |
|                 |                        |         | 660               | 850  | 1220 | 1562 | 0,47              | 0,85 |
| Pt500(90)385    | 0,1                    | 0,01    | -200              | 100  | -328 | 212  | 0,22              | 0,4  |
|                 |                        |         | 100               | 400  | 212  | 752  | 0,29              | 0,53 |
|                 |                        |         | 400               | 660  | 752  | 1220 | 0,35              | 0,63 |
|                 |                        |         | 660               | 850  | 1220 | 1562 | 0,41              | 0,74 |
| Pt1K(90)385     | 0,1                    | 0,01    | -200              | 100  | -328 | 212  | 0,14              | 0,26 |
|                 |                        |         | 100               | 400  | 212  | 752  | 0,2               | 0,36 |
|                 |                        |         | 400               | 660  | 752  | 1220 | 0,26              | 0,47 |
|                 |                        |         | 660               | 850  | 1220 | 1562 | 0,31              | 0,56 |
| P50(90)391      | 0,1                    | 0,01    | -200              | 100  | -328 | 212  | 0,21              | 0,38 |
|                 |                        |         | 100               | 400  | 212  | 752  | 0,28              | 0,51 |
|                 |                        |         | 400               | 660  | 752  | 1220 | 0,35              | 0,63 |
|                 |                        |         | 660               | 850  | 1220 | 1562 | 0,4               | 0,72 |
|                 |                        |         | 850               | 1100 | 1562 | 2012 | 0,49              | 0,89 |
| P100(90)391     | 0,1                    | 0,01    | -200              | 100  | -328 | 212  | 0,15              | 0,27 |
|                 |                        |         | 100               | 400  | 212  | 752  | 0,2               | 0,36 |
|                 |                        |         | 400               | 660  | 752  | 1220 | 0,26              | 0,47 |
|                 |                        |         | 660               | 850  | 1220 | 1562 | 0,31              | 0,56 |
|                 |                        |         | 850               | 1100 | 1562 | 2012 | 1,38              | 2,49 |
| P100(90)392     | 0,1                    | 0,01    | -260              | 100  | -436 | 212  | 0,13              | 0,24 |
|                 |                        |         | 100               | 400  | 212  | 752  | 0,19              | 0,35 |
|                 |                        |         | 400               | 630  | 752  | 1166 | 0,25              | 0,45 |
| M10(90)427      | 0,1                    | 0,1     | -200              | 260  | -328 | 500  | 0,85              | 1,53 |
| M50(90)428      | 0,1                    | 0,01    | -200              | 200  | -328 | 392  | 0,21              | 0,38 |
| M100(90)428     | 0,1                    | 0,01    | -200              | 200  | -328 | 392  | 0,14              | 0,26 |
| M100(90)617     | 0,1                    | 0,01    | -60               | 180  | -76  | 356  | 0,11              | 0,2  |

|                    |     |      |      |     |      |     |      |      |
|--------------------|-----|------|------|-----|------|-----|------|------|
| <b>H120(90)672</b> | 0,1 | 0,01 | -80  | 260 | -112 | 500 | 0,1  | 0,18 |
| <b>P100(90)JIS</b> | 0,1 | 0,01 | -200 | 100 | -328 | 212 | 0,14 | 0,26 |
|                    |     |      | 100  | 500 | 212  | 932 | 0,22 | 0,4  |
| <b>YSI(90)400</b>  | 0,1 | 0,01 | 15   | 150 | 59   | 302 | 0,02 | 0,04 |

Read accuracy is based on 4 wire input.  
Source accuracy in terminals 2 wire source.

## Pressure modules, Barometric option (BARO) and APM CPF

| APM CPF Type (s)               | Gauge |      |        |       |       |        | 12 month Accuracy ±<br>0 to 30 % range | 12 month Accuracy ±<br>30 to 110% range | 12 month Accuracy ±<br>Vacuum % FS |
|--------------------------------|-------|------|--------|-------|-------|--------|--|---|------------------------------------|
|                                | Bar   |      | MPa    |       | psi   |        |  |   |                                    |
| 3 bar<br>300 kPa<br>30 psi     | -1    | 3    | -0.099 | 0.300 | -14.5 | 30     | 0.0075% FS                             | 0.025% RDG                              | 0.06% FS                           |
| 10 bar<br>1 MPa<br>100 psi     | -1    | 10   | -0.099 | 1.0   | -14.5 | 100    | 0.0075% FS                             | 0.025% RDG                              | 0.06% FS                           |
| 30 bar<br>3 MPa<br>300 psi     | -1    | 30   | -0.099 | 3.0   | -14.5 | 300    | 0.0075% FS                             | 0.025% RDG                              | 0.06% FS                           |
| 100 bar<br>10 MPa<br>300 psi   | 0     | 100  | 0      | 10.0  | 0     | 1 000  | 0.015% FS                              | 0.05% RDG                               | N/A                                |
| 300bar<br>30 MPa<br>3 kpsi     | 0     | 300  | 0      | 30.0  | 0     | 3 000  | 0.015% FS                              | 0.05% RDG                               | N/A                                |
| 700 bar<br>70 MPa<br>10 kpsi   | 0     | 700  | 0      | 70.0  | 0     | 10 000 | 0.03% FS                               | 0.1% RDG                                | N/A                                |
| 1000 bar<br>100 MPa<br>15 kpsi | 0     | 1000 | 0      | 100.0 | 0     | 15 000 | 0.03% FS                               | 0.1% RDG                                | N/A                                |

| Absolute pressure APM CPF with ASC-400 BARO option / 12 month Accuracy $\pm$ |                          |                      |                |                     |                         |
|--|--------------------------|----------------------|----------------|---------------------|-------------------------|
| 3 bar APM CPF  | Accuracy $\pm$           | 300 kPa APM CPF      | Accuracy $\pm$ | 30 psi APM CPF      | Accuracy $\pm$          |
| 0.0138 to 1 barA   | 0.0008 barA              | 1.38 to 100 kPaA     | 0.08 kPaA      | 0.2 to 14.5 psiA    | 0.011 psiA              |
| 1 to 4 barA  | 0.025% RDG + 0.0003 barA | 100 to 400 kPaA      | 0.025% RDG +   | 14.5 to 44.5 psiA   | 0.025% RDG + 0.003 psiA |
| 10 bar APM CPF   | Accuracy $\pm$           | 1 MPa APM CPF        | Accuracy $\pm$ | 100 psi APM CPF     | Accuracy $\pm$          |
| 0.0138 to 1 barA   | 0.0008 barA              | 0.00138 to 0.1 MPaA  | 0.00008 MPaA   | 0.2 to 14.5 psiA    | 0.011 psiA              |
| 1 to 4 barA  | 0.001 barA               | 0.1 to 0.4 MPaA      | 0.0001 MPaA    | 14.5 to 44.5 psiA   | 0.011 psiA              |
| 4 barA to 11 barA  | 0.025% RDG               | 0.4 MPaA to 1.1 MPaA | 0.025% RDG     | 44.5 to 114.5 psiA  | 0.025% RDG              |
| 30 bar APM CPF   | Accuracy $\pm$           | 3 MPa APM CPF        | Accuracy $\pm$ | 100 psi APM CPF     | Accuracy $\pm$          |
| 0.014 to 1 barA  | 0.001 barA               | 0.0014 to 0.1 MPaA   | 0.001 MPaA     | 0.2 to 14.5 psiA    | 0.01 psiA               |
| 1 to 10 barA   | 0.003 barA               | 0.1 to 1.0 MPaA      | 0.003 MPaA     | 14.5 to 104.5 psiA  | 0.03 psiA               |
| 10 barA to 31 barA   | 0.025% RDG               | 1.0 MPaA to 3.1 MPaA | 0.025% RDG     | 104.5 to 314.5 psiA | 0.025% RDG              |

Specified temperature range -10 to 50°C / 14 to 122°F (APM CPF & BARO option) Vacuum FS, 1 bar / 100 kPa / 14.5 psi. F.S. (full scale) is the numerical value of the positive pressure range. Accuracy includes hysteresis, nonlinearity, repeatability and reference standard uncertainty, 1 Year typical longterm stability, operated inside the rated temperature span and pressure range. Requiring frequently zeroing.

## Additional specifications - directives observed

| Standards         | Description   |
|-------------------|---|
| 2014/30/EU :      | EMC Directive   |
| EN61326-1: 2013 : | Electrical equipment for measurement, control and laboratory use – EMC-requirements: Class B equipment. |
|                   | Emmission :   |
|                   | CISPR 11, Class B   |
|                   | Immunity :  |
|                   | IEC 61000-4-2 ESD   |
|                   | IEC 61000-4-3 Electromagnetic field   |
|                   | IEC 61000-4-3 Voltage dip   |
|                   | IEC 61000-4-11 Short interruptions  |
|                   | IEC 61000-4-4 Burst   |
|                   | IEC 61000-4-5 Surge   |
|                   | IEC 61000-3-6 Conducted RF  |
|                   | 4 kV contact / 8 kV air   |
|                   | 3 V/m 80 MHz to 1 GHz   |
|                   | 3 V/m 1.4 GHz to 2 GHz  |
|                   | 1 V/m 2 GHz to 2.7 GHz  |
|                   | 0% during half cycle  |
|                   | 0% during 1 cycle   |
|                   | 40% during 10/12 cycles   |
|                   | 70% during 25/30 cycles   |
|                   | 0% during 250/300 cycles  |
|                   | 1 kV  |
|                   | ½ kV  |
|                   | 3V (150 kHz to 80 MHz)  |

## 12.0 List of accessories

All parts listed in the list of accessories is available from the factory through our dealers. Please contact your dealer for assistance if you require parts, which do not appear in the list.

### List of accessories

| Accessories  | Part no.   |
|--|--|
| Large padded soft case                                 | 127415   |
| Soft bag incl. strap                                   | 128848   |
| 6 x 1.5V AA Ni-MH rechargeable batteries               | 128859   |
| External Power Supply/Charger 9VDC/200mA-230VAC/115VAC | 124720   |
| Thermocouple male plug type K - Yellow                 | 120517   |
| Thermocouple male plug type N - Orange                 | 120514   |
| Thermocouple male plug type T - Blue                   | 120515   |
| Thermocouple male plug type J - Black                  | 120516   |
| Thermocouple male plug type R/S – Green                | 120518   |
| Thermocouple male plug type Cu-Cu - White              | 120519   |
| Extension cable for type K – 5 meter                   | 121983   |
| Extension cable for type N – 5 meter                   | 122523   |
| Cable 2 m (6.6ft.) with LEMO/Banana connectors         | 65-PT100-LB-CABLE  |
| APM Pressure Modules                                   | Contact your local dealer for various options or visit our website :<br><a href="http://www.ametekcalibration.com">www.ametekcalibration.com</a> |

**AMETEK Test & Calibration Instruments**

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**JOFRA Calibration Instruments***Temperature Calibrators*

Portable dry-block calibrators, precision thermometers and liquid baths. Temperature sensors for industrial and marine use.

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Convenient electronic systems ranging from -25 mbar to 1000 bar - fully temperature-compensated for problem-free and accurate field use.

*Signal Instruments*

Process signal measurement and simulation for easy control loop calibration and measurement tasks.

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Pneumatic floating-ball or hydraulic piston dead weight testers with accuracies to 0.015% of reading. Pressure generators delivering up to 1,000 bar.

**Crystal Pressure**

Digital pressure gauges and calibrators that are accurate, easy-to-use and reliable. Designed for use in the harshest environments; most products carry an IS, IP67 and DNV rating.

**Lloyd Materials Testing**

Materials testing machines and software that guarantees expert materials testing solutions.

Also covering Texture Analysers to perform rapid, general food testing and detailed texture analysis on a diverse range of foods and cosmetics.

**Davenport Polymer Test Equipment**

Allows measurement and characterization of moisture-sensitive PET polymers and polymer density.

**Chatillon Force Measurement**

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**United Kingdom**

Tel +44 (0)1243 833 302  
caluk.sales@ametek.com

**France**

Tel +33 (0)1 30 68 89 40  
general.lloyd-instruments@ametek.fr

**Germany**

Tel +49 (0)2159 9136 510  
info.mct-de@ametek.de

**Denmark**

Tel +45 4816 8000  
jofra@ametek.com

**USA**

Florida  
Tel +1 (800) 527 9999  
cal.info@ametek.com

**California**

Tel +1 (800) 444 1850  
crystal@ametek.com

**India**

Tel +91 22 2836 4750  
jofra@ametek.com

**Singapore**

Tel +65 6484 2388  
jofra@ametek.com

**China**

Shanghai  
Tel +86 21 5868 5111

**Beijing**

Tel +86 10 8526 2111  
jofra.sales@ametek.com.cn